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WIC Dietary Assessment Validation Study

Final Report

United States Department of Agriculture
Food and Nutrition Service
USDA Contract #53-3198-2-032

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SECTION 1 - EXECUTIVE SUMMARY

The Food and Nutrition Service (FNS) of the U. S. Department of Agriculture initiated research in September 1992 to validate two sets of food frequency questionnaires (FFQs) in a study population made up of women and children eligible for the Special Supplemental Food Program for Women, Infants and Children (WIC). The purpose was to determine the comparative performance of these FFQs in ranking respondents with respect to the " true " dietary intake. In this study, true dietary intake was measured by three non-consecutive 24-hour diet recalls collected through a telephone interview. The two food frequency questionnaires tested were the:

- *Harvard FFQ* - Women's Food Frequency Questionnaire (WFFQ) and Children's Food Frequency Questionnaire (CFFQ) developed by Dr. Jane Gardner at Harvard University; and the
- *Block FFQ* - developed by Dr. Gladys Block at the University of California, Berkeley.

Food frequency questionnaires attempt to estimate dietary intake of an individual by asking how often specific foods are consumed. Based upon previous studies, the Harvard and Block FFQs each ask about a list of foods most commonly consumed by participants in the WIC program. These two FFQs differ on several dimensions, such as the number of food items (Harvard, 80 items; Block, 65 items), specific food items, the way food items are grouped, the frequency categories, and scoring methods. The Block FFQ also differs from the Harvard FFQ in that it asks an individual to approximate the usual portion size (small, medium or large) of each food item consumed.

Both the Harvard and Block FFQs have a woman's version and a child's version. The woman's version is designed for a woman to fill out about her own diet while the child's version is designed for a mother to fill out about the diet of her child (age 1-4).

Study Population

The population for this study consisted of four WIC categories and three ethnic/racial groups. The four WIC categories studied were:

- Pregnant women;
- Breastfeeding, postpartum women;
- Non-breastfeeding, postpartum women; and
- Children ages 1.0 through 4.9 years.

Within each of these four WIC categories, study participants were recruited to represent the following three "self-identified" ethnic/racial groups:

- African American;
- Hispanic; and
- White.

The study population was recruited from within the East, West, Southwest and Central regions of the United States. The specific field sites selected for recruitment were:

- Hempstead, New York;
- Berkeley and Oakland, California;
- Houston, Texas; and
- Cincinnati, Ohio.

Sample Design and Size

A stratified, rectangular sample design was used in this study. For each of the two FFQs (Harvard and Block), approximately 75 women in each of the three WIC categories (pregnant, breastfeeding and non-breastfeeding) and 75 children were sought. On the dimension of ethnicity, the target sample size was approximately 75 women in each of the three ethnic groups. Based on this design, a minimum of 600 participants, i.e., 300 for each of the two FFQs recruited across the four geographic regions, constituted this validation study's desired sample size. By the completion of the data collection period (July 1993 to January 1994) a combined total of 969 women and children had been

recruited, and of these, 650 had sufficiently adequate 24-hour recall data to be used in the final analyses.

Study Data

Participants recruited into the study were required to complete an initial administration of either the Harvard FFQ or the Block FFQ, three non-consecutive 24-hour diet recalls, and a second administration of the FFQ. The three diet recalls were collected by telephone interviews utilizing two-dimensional food models and were analyzed with the Minnesota Nutrition Data System (NDS 32). The recalls were used as the reference data for the validation study, providing an estimate of usual intake for the nutrients of interest to FNS and the WIC program. In analyzing the study data, the recall reference data were compared to the nutrient intake estimates resulting from the FFQ administrations. The study also compared manual and computerized scoring methods for both types of FFQs.

The following nutrients are targeted by the WIC Program and were examined in this study: protein, vitamin A, vitamin C, iron and calcium. Additionally, estimates of total energy were assessed because energy is important to pregnancy, lactation, growth and child development, and because the estimates are potentially useful for performing nutrient density calculations.

In addition to the validation and scoring investigations, an evaluation of FFQ usability was conducted. Data were collected systematically for both sets of FFQs, on each of the following:

<u>Usability for the client</u>

- Time required for FFQ completion by participants
- Amount of assistance required by participants
- Number and type of errors

<u>Usability for WIC staff</u>

- Time required to manually score FFQs
- Ease of manual scoring

Assessment of Usability by WIC Agencies

- Usefulness of FFQs to WIC staff for nutrition education and determining eligibility
- Opinions and recommendations from WIC staff.

Analytic Approach

A central purpose of FFQs, both for research and for WIC purposes, is to place individuals along a distribution of intake from low to high. Accuracy of the point estimates (group means), while useful for some purposes, provides no test whatsoever of the ability of an instrument to determine correctly whether an individual's intake is low or high. FFQ group means can be identical to diet recall group means and yet provide no ability to rank individuals; and conversely, FFQ group means can be significantly different from the diet recall means, but the FFQ may rank individuals quite well. Therefore, to be relevant for estimating whether an individual is at increased nutritional risk, a proposed FFQ must produce adequate correlations with reference data. It is correlation or categorization that forms the criterion for whether an instrument can provide a reasonably accurate estimation of an individual's location along the continuum from low to high intake.

RESULTS

A Balanced Study Population

The recruited Harvard and Block study populations were well balanced, that is, not statistically different from each other in age, distribution among WIC categories, ethnicity, prior WIC experience, language (Spanish and English) and education. This remained true after cases with questionably high diet recall nutrient values were dropped from the analyses.

Rapid Completion of FFQs

Both types of FFQs were completed in less than 10 minutes by both African-American and White study subjects, and in less than 15 minutes by Hispanic study

subjects. For all women, the Block FFQ took longer to complete than the Harvard FFQ with a median time of 9.5 minutes for Block *versus* 8 minutes for Harvard.

The Block FFQ Is More Valid for White and African-American Women

The Block FFQ achieved higher correlations than the Harvard FFQ in three-fourths of the nutrient correlations examined. Among African-American and White women, 9 of the 12 Block FFQ correlations (six nutrients per ethnic group) were equal to or greater than 0.4, while only one of 12 Harvard FFQ correlations was that high (note: perfect correlation = 1.0). In addition to agreement as estimated by correlations, the Block FFQ performed better than the Harvard FFQ for African-American and White women in its ability to categorize them as *high*, *medium* or *low* with respect to their true dietary intake. The Block FFQ showed significant agreement between quartile rankings by FFQ and 24-Hour Recall nutrient estimates for all six nutrients of interest (energy, protein, vitamin A, vitamin C, iron and calcium). For the Harvard FFQ, statistically significant agreement was seen for protein and calcium only.

Use of Small-Medium-Large Portion Sizes Improves Validity of the Block FFQ

The Block FFQ permits respondents to describe their usual portion of each food item as small, medium or large. These reported portion sizes were used in the analyses of this validation study. The effect of eliminating these multiple portion sizes from the questionnaire for purposes of simplification was examined. When a medium portion size was substituted for all responses and the correlations recalculated, the results were poorer. The use of a standard medium portion size with the Block FFQ is therefore not recommended.

Neither FFQ Is Valid for Hispanic Women

Although the Harvard FFQ had generally higher correlations than Block for Hispanic women, validity correlations for both were quite poor and thus neither FFQ is recommended in a self-administered form for either nutrient estimates or to evaluate WIC

eligibility. For Hispanic women, both FFQs could possibly be used for nutrition education and counseling purposes but not for eligibility determination.

Neither FFQ Is Valid for Children

Among mothers and caretakers reporting for children, ages 1-4, it was found that neither FFQ can be recommended for use in a self-administered form to estimate nutrient intake or to evaluate WIC eligibility. It is possible, however, that a simple set of brief behavioral questions, such as "How often do you give your child fruit?" or "How often do you give your child vegetables?," may be more appropriate for this group. This approach could provide sufficiently useful information for education and counseling purposes and perhaps for eligibility as well. Obtaining precise nutrient estimates to evaluate WIC eligibility for children may not be possible by any method because of the measurement errors associated with proxy reporting.

Manual Scoring May Be Useful to Evaluate Eligibility

It was found that the manual scoring of both instruments is rapid and easy, once familiarity with the scoring system is attained. The amount of time to manually score the participants' first FFQ (FFQ-1) was virtually identical for both Harvard and Block FFQs, with a median time of 3.0 minutes and an average of just under 4 minutes for both. These identical averages both went down to 3.2 minutes for the second FFQ administration (FFQ-2).

In terms of validity, flexibility, and the ability to distinguish between groups with lower or higher nutrient intakes, the Block manual scoring system performed better than the Harvard manual scoring. Among African-American and White women classified as either "low" or "adequate" using the Block manual scores, the "low" group had a significantly lower mean nutrient intake (24-hour recall data) than the "adequate" group for all five nutrients of interest. Only one Harvard FFQ manual score (calcium) achieved statistical significance. Because groups with low nutrient intakes can better be identified by the Block manual score, this score may be useful for evaluating eligibility.

Below the RDA for One or More Nutrients is an Inappropriate Eligibility Criterion

On the basis of the diet recall data alone, 95% of the participants in this validation study were below 100% of the RDA on at least one of the five nutrients of interest (protein, vitamin A, vitamin C, iron, calcium). An eligibility criterion of falling below 100% of the RDA on one or more of the five nutrients would then qualify virtually all income-eligible women and children.

Usefulness for Nutrition Education

Opinions were solicited from WIC clinic staff in three states unconnected with the research project. They voluntarily provided assessments of the FFQs' usability. They reported that both FFQs were generally useful in collecting dietary assessment information that was helpful in providing nutrition education to WIC clients. Some believed that the Harvard manual score related better to WIC eligibility criteria and to nutrition education models such as the "food pyramid," and they liked the manual score's easy, *pass-fail* system for rating each food group. WIC agency staff also felt that the Block portion quantity question regarding *how much each time* proved useful for discussing portion sizes with clients.

Few Errors by Most Participants

Relatively little assistance was required by respondents in completing the FFQs. Average assistance scores for both Harvard and Block FFQs were between *no assistance* and *little assistance*. Neither the Harvard nor the Block FFQ had a sufficiently large number of skipped food items to be considered a serious source of error.

FURTHER RESEARCH

1) Although the FFQs cannot be recommended for Hispanic women, this limitation may be possible to correct with further work. Some examples would be: examination of FFQ validity when administered by interview; and investigating culturally-specific issues related to concepts of food, diet and frequency of food intake.

2) The Block estimates of vitamin C and calcium can be improved by modifying the frequency categories that were used to assess juices and milk in this study's version of the Block FFQ. Estimates of these nutrients in other validation studies with the Block FFQ were much better using different frequency categories for juices and milk.

3) Block manual score cutpoints can be identified that will more accurately reflect the proportion of the population with nutrient intake below the RDA. The cutpoints for manual scoring used in this study were set before the intake distribution for this WIC population was known.

4) Because neither FFQ worked well for children, a brief set of questions can be identified and tested for assessing appropriate dietary intake among children.

SUMMARY

In 1985 the General Accounting Office (GAO) called for a more valid and consistent method of assessing dietary risk in the WIC program and recommended that there be more standardization in the way that WIC eligibility is determined throughout the country. This study has provided a basis for meeting these recommendations. The validity and limitations of these two FFQs are now known. These results provide a foundation for achieving the desired validity and consistency in dietary assessment in the WIC program.

Among mothers and caretakers reporting for children, ages 1-4, neither the Harvard nor Block FFQ can be recommended for use in a self-administered form to estimate nutrient intake or to evaluate WIC eligibility. For women, however, improvements are still needed and are possible for both FFQs. Even in its present state, the Block FFQ produces correlations with reference data for White and African-American WIC-eligible women which are not substantially different from correlations previously demonstrated in better educated groups. Neither FFQ performs adequately for Hispanic women. Some of the reasons for this may pertain as much to the adequacy of the reference data as to the adequacy of the FFQs themselves. Thus, the potential usability of FFQs for Hispanic populations should not be discounted, but further investigation is clearly needed.

SECTION 2 - INTRODUCTION

2.1 STUDY OVERVIEW

The U.S. Department of Agriculture, Food and Nutrition Service (FNS) conducted this study to evaluate the validity of two sets of food frequency questionnaires (FFQs) for potential use in screening women and children for eligibility in the Special Supplemental Food Program for Women, Infants, and Children (WIC). Each set contained one FFQ developed for assessing the dietary intakes of pregnant, breastfeeding, and non-breastfeeding postpartum women and one FFQ for assessing the dietary intakes of children 1-4 years of age (age 12 months through 4.99 years). A woman's food frequency questionnaire (WFFQ) and a child's food frequency questionnaire (CFFQ) were previously developed by the Harvard University School of Public Health (HSPH) for FNS through a cooperative agreement (Gardner et al., 1992). In addition, modified versions of the Block/National Cancer Institute Health Habits and History FFQ were developed and tested in this study. The validity of the two HSPH food frequency instruments and the two Block FFQ instruments were evaluated for low-income women and young children against a standard reference. The performance of the two sets of FFQs was compared to determine which instruments had the greater validity relative to the standard. Note that in the remainder of this report, these instruments are referred to as the 'Harvard" FFQ and the "Block" FFQ.

Research objectives

The primary objective of this research was to validate two pairs of food frequency instruments for women and children (ages 1-4) with regard to their effectiveness and usability in the following respects:

- Validity of nutrient estimates in relation to estimates based on multiple 24-hour recalls;

- Ability to measure dietary intake in a manner usable to screen applicants for WIC eligibility;
- Feasibility of use in busy WIC clinics, and acceptability to WIC participants and staff;
- Suitability for various ethnic groups; and
- Accurateness and simplicity of manual scoring.

In order to achieve these objectives with the greatest scientific rigor and validity, several other objectives were also necessary:

- Review and critique dietary assessment instruments potentially of use in estimating usual dietary intake of women and children in the WIC program;
- Review and critique existing manual and computerized scoring methods for FFQs; and
- Review and critique validation methodologies.

2.2 BACKGROUND

The WIC Program

The Child Nutrition Act (CNA) of 1966, as amended, established the WIC Program to provide supplemental foods, health care referrals, and nutrition education at no cost to low-income pregnant, breastfeeding and non-breastfeeding postpartum women, infants and young children up to five years of age who are found to be at nutritional risk. To be eligible, persons must: 1) meet a State residency requirement; 2) meet an income standard or participate in Aid to Families with Dependent Children (AFDC), the Food Stamp Program or Medicaid; and 3) be individually determined to be at nutritional risk by a competent professional authority.

The goal of the WIC Program is to improve the health of program participants through provision of:

<u>Supplemental Foods</u>. WIC makes available seven food packages that are designed for different categories of participants. These packages contain foods that are

good sources of nutrients most likely to be lacking in the WIC population's diet -- protein, iron, calcium, and vitamins A and C. The food items provided include: iron-fortified infant formula and cereal, fruit or vegetable juice, milk, cheese, eggs, peanut butter, dry beans or peas, carrots, and tuna. These foods are not intended to provide the total dietary needs but rather to supplement the diets of participants.

Nutrition Education. Nutrition education efforts in WIC are aimed at assisting the individual at nutritional risk to achieve positive changes in food habits, and consequently improve nutritional status and prevent nutrition-related problems. The WIC regulations require that State agencies spend the aggregate sum of one-sixth of their WIC nutrition services and program administration grant on nutrition education activities plus their prorata share of the $8 million earmarked for breastfeeding promotion and support.

Access to Health Care. The WIC Program operates as an adjunct to good health care. Participant referrals to health care are provided. WIC and the public health community work collaboratively to ensure better health and nutritional status for a vulnerable population.

The program has undergone rapid expansion since its inception. Funding has increased from $20 million in 1974 to approximately $2.6 billion in Fiscal Year 1991. Average monthly participation has increased from 87,657 persons in Fiscal Year 1974 to 4.88 million persons in Fiscal Year 1991.

The WIC Program functions administratively at three levels: Federal, State, and local. FNS, through its seven regional offices, provides cash grants to designated WIC State agencies for program administration and operations. Regulations governing WIC are promulgated by FNS, and FNS Regional Office staff monitor State agencies for compliance to these regulations. WIC State agencies are responsible for the establishment, monitoring, and reporting of local WIC agency activities to FNS. These State agencies allocate funds to participating local WIC agencies within their areas. Local agencies are most often city or county health departments, but also may be any of a variety of public or nonprofit health or human service organizations such as hospitals, maternal

and child health groups, or community action agencies. The funds received by local WIC agencies are used to provide supplemental foods to WIC participants and to pay administrative costs, including the costs of certifying applicants for eligibility and providing nutrition education and counseling.

To qualify for WIC benefits, an applicant must meet certain eligibility requirements:

Categorical Status. Eligible categories include women during pregnancy and for the first 6 weeks after delivery, breastfeeding women up to one year postpartum, non-breastfeeding postpartum women up to six months postpartum, infants up to one year of age, and children ages 1 through 4 years old.

Income. The income limit is set by each State agency, but cannot exceed 185 percent or be less than 100 percent of the U.S. Poverty Income Guideline for each family size.

Nutritional Risk. Applicants who meet the categorical and income requirements must be certified by a competent professional authority to be at nutritional risk. Screening for nutritional risk includes anthropometric measurements, blood tests for anemia, health history, and dietary assessment. Nutritional risk may be based on medical, clinical, and/or dietary risk criteria.

The level of WIC Program operation at the local agency level depends on the level of funding that is available. For each local agency, a maximum caseload is determined, depending on its assigned annual funding level and predicted caseload turnover. When local WIC agencies reach the maximum participation level with the available funding, a system of priorities is followed in allocating "slots" to eligible applicants. Seven priority levels are defined, based on the applicant's categorical status and type of nutrition risk condition, as follows:

I. Pregnant and breastfeeding women and infants at nutritional risk as demonstrated by anthropometric or hematological assessment or by other documented nutritionally-related medical condition.

II. Infants up to six months of age whose mothers participated in WIC during pregnancy, or who were at nutritional risk during pregnancy.

III. Children at nutritional risk, as demonstrated by anthropometric or hematological assessment or other documented nutritionally-related medical condition.

IV. Pregnant and lactating women and infants at nutritional risk as demonstrated by inadequate dietary pattern.

V. Children at nutritional risk due to inadequate dietary pattern.

VI. Postpartum non-lactating women at nutritional risk based on either medical or dietary criteria.

VII. Previously certified participants likely to regress in nutritional status without continuation of supplemental foods.

State agencies have the option of creating subpriorities within priorities and expanding priority levels I, II, III, IV, or V to include high-risk postpartum women. Four of the seven priorities in the existing priority system for WIC eligibility certification are based on inadequate diet alone. Eligibility is based on medical risk factors as well as inadequate diet. Inadequate diet alone is given lower priority.

Rationale for the Study

In the WIC Program, State agencies have always had the option of developing their own methods to assess dietary intake of participants for program eligibility. In 1985, a GAO report entitled "Need to Foster Optimal Use of Resources in the Special Supplemental Food Program for Women, Infants and Children (WIC)" suggested that there was a need to refine dietary assessment methodology to make it more reliable and to increase uniformity in assessing dietary risk across States. A survey of State WIC agencies conducted by FNS in the fall of 1988 showed that a wide range of methodologies was being used for dietary assessment. Approximately 80 percent of the State WIC agencies surveyed were using a food frequency questionnaire, either alone or in

conjunction with a 24-hour recall, to assess dietary intake of participants. Only one of the 63 State agencies responding had tested the validity and reliability of its instrument.

The Focus on Management (FOM) Nutrition Services Standards released in 1988 encouraged States to use standardized dietary assessment procedures that were based on professionally recognized guidelines and specifically to use a food frequency questionnaire when dietary risk was the only eligibility factor.

To explore the need for additional research in the area of dietary assessment relevant to the WIC Program, FNS convened a task force meeting on dietary assessment in July, 1989, to: 1) identify and examine dietary assessment methodologies applicable to the WIC Program; and 2) explore the possibility of FNS researching, developing and endorsing a dietary assessment protocol, methodology, and/or range of approaches for State agency use. The recommendations of the task force regarding the use of a dietary assessment instrument for eligibility screening in the WIC Program consisted of the following:

- FNS should consider pursuing research in the area of dietary assessment;
- A food frequency instrument is the most appropriate instrument for screening WIC applicants who are women or children, but not for infants;
- In addition to screening for inadequate diet, the instrument should also allow for triaging of services needed by the participant and for provision of general nutrition education;
- The instrument should be designed in a paper format that could be self-administered by clients and manually scored/evaluated. In addition, the instrument should lend itself to computer application in administration and evaluation;
- Evaluation of the instrument should take 2-5 minutes and be able to be performed by a paraprofessional;
- Two instruments from existing methodologies, if possible, should be compared to a standard reference to determine which instrument has the better reliability and validity relative to the standard;

- Evaluation of excessive intake should not be part of the instrument, but could be added at State option;
- The Continuing Survey of Food Intake by Individuals (CSFII) should be the reference data base; and
- Dietary inadequacy values would be determined by each State and, to assist in that determination, any point values used in scoring would be defined as to how they correlate with the percentage of the RDA's for targeted nutrients.

Based on these recommendations, FNS contracted with HSPH in 1990 for the development of two food frequency questionnaires and their accompanying scoring methods, both manual and computerized, for use in determining WIC eligibility for women and children. Those two instruments, and two instruments developed by Dr. Gladys Block, were tested in the present study.

Any dietary assessment method, when validated against a gold standard, will produce moderate results at best. No method will agree perfectly with the gold standard, for a variety of reasons which may include not only imperfections in the test method but also imperfections in the reference method. If only one FFQ is tested, the FFQ will be deemed to have been "validated" simply on the grounds that a validation study has been performed. Thus, in order for methodologies to be constantly improved, they must constantly be tested against one another. In a validation study, two such methods must be validated against the same reference data collected for the same number of days, in a population with the same age, sex and demographic characteristics, and with data collected under the same conditions and using the same procedures. In this way, an evolving set of instruments can be developed, each one better than the last. The purpose of this research was to conduct such a validation, to identify the better instrument and ultimately improve the methods available for use in the WIC program.

SECTION 3 - METHODS

3.1 OVERALL STUDY DESIGN

The study design used to evaluate the validity of the Harvard and Block FFQs consisted of three parts: FFQ administration at the clinic, three non-consecutive 24-hour recalls administered by telephone, and a repeat FFQ administration at the clinic (see Figure 3-1). At the time of recruitment, participants were randomly assigned either a Block or Harvard FFQ. Three 24-hour diet recalls were collected over a 2 to 5 week period to obtain referent or " true" dietary intake. A set of two-dimensional food models was provided to each participant to assist in the quantifying of portion sizes. The total time period from recruitment to the final FFQ was approximately five weeks. Both weekday and weekend days were included in the reference data.

Figure 3-1

Schematic of Validation Study Design for Each Type of FFQ Tested

Recruited participants are randomized into Harvard or Block FFQ groups at t-0

Time	t-0	t-1	t-2	t-3	t-4
Instrument	**FFQ-1**	**RECALL-1**	**RECALL-2**	**RECALL-3**	**FFQ-2**
Method	Initial self-administration	Telephone interview	Telephone interview	Telephone interview	Repeat self-administration
Location	WIC Clinic	Residence	Residence	Residence	WIC Clinic

The three non-consecutive recalls, 4 to 8 days apart, provided an estimate of usual intake over a 3 to 4 week period for protein, iron, calcium, and vitamin C. Vitamin A intake is so variable from day to day that there may be no feasible number of days which could provide an adequate reference against which the FFQs could be compared for validity. Thus, the estimate of validity for vitamin A represents a conservative, low estimate of the true validity. The true validity for vitamin A is most likely higher than appears from this validation study.

Study Population

The study population consisted of four WIC categories and three ethnic/racial groups (referred to in this report as "ethnic" groups). The four WIC categories studied were:

- Pregnant women;
- Breastfeeding, postpartum women;
- Non-breastfeeding, postpartum women; and
- Children ages 1 through 4 years (12 months through 4.99 years).

Within each of the four WIC categories, study participants were recruited to represent the following three "self-identified" ethnic groups:

- African American;
- Hispanic; and
- White.

The study population was recruited in four distinct geographic areas of the United States: East, West, Southwest and Central regions. The specific field sites were:

- Hempstead, New York;
- Berkeley and Oakland, California;
- Houston, Texas; and
- Cincinnati, Ohio.

Sample Size

A stratified, rectangular sample design was used in this study (see Table 3-1). For each of the two FFQs (Harvard and Block), a minimum sample size of 75 women in each of the three WIC categories (pregnant, breastfeeding and non-breastfeeding) and a minimum sample of 75 children was sought. On the dimension of ethnicity, a minimum sample of 75 women in each of the three ethnic groups, plus 25 children per group, provides sufficient power to assess validity within each ethnic group and even greater power when all three ethnic groups are combined. Thus, a minimum total sample of 600 persons, i.e., 300 for each of the two FFQs, recruited from four geographic regions and made up of three ethnicities, constitutes the validation study target population.

Table 3-1

Target Sample Size per FFQ Type by WIC Category and Ethnicity

	African-American	Hispanic	White	*Category Totals*
Women				
Pregnant	25	25	25	*75*
Postpartum, Breastfeeding	25	25	25	*75*
Postpartum, Non-breastfeeding	25	25	25	*75*
sub-total	*75*	*75*	*75*	**225**
Children				
Ages 1 through 4	25	25	25	**75**
				Grand Total
Ethnic totals	*100*	*100*	*100*	**300**

Evaluation of FFQ Usability

During the validation study, data were collected systematically for both sets of FFQs, on each of the following:

Usability for the client

- Time required for FFQ completion by participants
- Amount of assistance required by participants
- Number and type of errors

Usability for WIC staff

- Time required to manually score FFQs
- Ease of manual scoring

Assessment of Usability by WIC Agencies

- Usefulness of FFQs to WIC staff for nutrition education and determining eligibility
- Opinions and recommendations from WIC staff.

Blind Analyses

To provide an unbiased comparison of the Harvard and Block FFQs during analysis, the Principal Investigator and Project Director were blinded to the FFQ identity (Harvard or Block) associated with each set of data. Prior to the examination of FFQ validity correlations, Harvard and Block FFQ data were assigned unique identifiers, "FFQ-X" and "FFQ-Y," by the project's senior analyst. Conclusions were made initially by project investigators without their knowing which validity correlations belonged to each FFQ type.

3.2 LITERATURE REVIEW

One of the project's objectives was to review existing dietary assessment instruments and their potential for use in estimating usual dietary intakes of women and children in the WIC Program. This covered reviewing FFQ validation methodologies and

identifying the strongest methodology for validating FFQ instruments; and reviewing existing manual and computerized methods of scoring data collected from FFQs. An extensive literature review was conducted. The review was conducted using reference sources at the University of California, Dr. Block's personal files, information from FNS, and relevant findings from the First International Conference on Dietary Assessment Methods (September 20-23, 1992, St. Paul, Minnesota).

3.3 DEVELOPMENT OF FFQS FOR USE WITH WIC POPULATIONS

The intent of this study was to examine two different FFQs, Block and Harvard, and determine which FFQ had the greater validity relative to a standard reference. It was essential that both FFQs be suitable for use with women and children in a WIC-eligible population. The Harvard FFQs examined in this study were the WFFQ and CFFQ developed by the Harvard School of Public Health (HSPH) under a cooperative agreement with FNS for use in screening women and children for eligibility in the WIC Program. For the purposes of this study, the existing Block FFQ was revised and enhanced. Modifications to both the Harvard and Block FFQs are described below and further in Appendix E-1.

The English version of the Harvard FFQ was used as developed for FNS. The study used a Spanish version of the Harvard FFQ produced in 1993, a slightly modified version of its 1991 Spanish version. Dr. Jane Gardner of the HSPH requested that the FFQ (1991, 1993 copyright versions) be validated in its present form as it is currently in widespread use.

The development and revision of an enhanced Block FFQ proceeded through a series of steps. To facilitate this process, working versions of the Block FFQ were constructed in a digital format which could be easily edited and modified. Data from NHANES II identifying the major food sources of iron, calcium, protein, and vitamins A and C were reviewed for the following groups (Block, unpublished data): Blacks Below Poverty, Whites Below Poverty, Black Females Ages 19-29, and White Females Ages 19-29. Foods that provided up to 80% of intake for each of these nutrients were examined

for inclusion in the Block FFQ. An examination of Hispanic HANES under separate funding was also undertaken by Dr. Block in order to incorporate those findings in the revised Block FFQ (Block et al., 1994). Also reviewed were a complete set of dietary assessment instruments used in WIC programs across the country.

The results of these reviews were used to create a revised Block FFQ that better reflected the nutrient sources for low-income women (African-American, Hispanic and White). Prototype instructions, format and design were prepared for use in focus group testing. The Block FFQ Spanish version was reviewed by the project's Hispanic diet specialist, Dr. Gabriela Villarreal, and a number of modifications to the translations and food terms were incorporated into the version used for pretesting.

The design of the Block FFQ is described in further detail in Appendix E-1, including the approaches used in developing the food list, portion sizes and manual scores.

FFQ Focus Group Testing

The project tested only the Block FFQ in two series of focus groups. Focus group testing of the Block FFQ was conducted at three WIC clinic sites in California. Participants were WIC or WIC-eligible women who were recruited two to three days prior to each focus group. The first site recruited only Spanish-speaking Hispanic women who examined only the Spanish FFQ. The second group consisted of only African-American women and the third group was a mixed ethnic group with African-American, White and English-speaking Hispanic participants; these groups reviewed the English FFQs only.

The Block FFQ was revised after use with the first two groups. Changes were made to punctuation, shading, paper color and some Hispanic food terms. Asking FFQ respondents to use X's to indicate foods consumed seemed to work better than check marks. Women completing FFQs for children requested a reminder on the top of each page of the FFQ that they were reporting for their child, not themselves. It was also found that respondents desired more specificity in the portion size descriptions for some foods, especially unitary items such as eggs, hot dogs, tortillas, etc. Grouping together foods

which specified a portion size such as a teaspoon, slice, etc., rather than a "small, medium or large" portion size proved more helpful.

The Spanish language FFQ required more revision than the English. The differences in Puerto Rican, Cuban and Mexican-American food terms needed to be examined closely to balance accuracy for one group against introducing confusion for the other groups. Discussions with WIC nutritionists and native speakers in Puerto Rico and California helped identify possible solutions, resulting in simplified food categories in most cases. Some descriptions, however, such as for soups and vitamins, were expanded.

The revised Block FFQ, both English and Spanish versions, was submitted to a second focus group testing with an African-American group and a Spanish-speaking Hispanic group. All previous modifications were incorporated and appeared to be successful in improving the effectiveness and usability of the Block FFQ.

The Harvard FFQ was not focus group tested in this study for several reasons: it was not part of the original study proposal; HSPH preferred that the Harvard English FFQ currently in use be validated without revision; and HSPH elected to undertake its own revision of the Harvard Spanish instrument (1993 copyright version). Minor suggestions for revising the Spanish FFQ, mostly improvements in food terms, were provided to the HSPH by the study. All suggested changes were incorporated into Harvard's revised Spanish FFQ (1993 copyright version). However, the revised Spanish instrument was not focus group tested as part of this study. It should be noted that field observations involving both WIC clients and staff had been performed on the Harvard FFQ under the earlier FNS cooperative agreement.

Final FFQ Redesign and Revision

Following focus group testing, final revisions were made to the Block FFQ including graphic enhancement to improve ease of use by both participants and administering staff. A key improvement was the incorporation of the manual scoring system into the printed instrument, thus eliminating a need for a separate scoring card. Improvements were also made to instructions, pagination and overall graphic presentation.

Spanish versions of both Block and Harvard FFQs were reviewed again by a qualified, nutritionist/translator who recommended a number of minor language changes to the Harvard and Block instruments. The changes included adding culturally appropriate synonyms for several food items. Both Spanish versions were also reviewed by a number of nutrition professionals working with low-income Hispanic populations in California, Texas, Florida and Puerto Rico.

A standardized cover sheet was graphically designed for administering all versions (women's and children's, English and Spanish) of the Block and Harvard instruments used in this validation study. In this manner, the covers of both sets of instruments were made to be identical, thus preventing any bias due to appearance. Some minor differences among the FFQ covers included different color papers for women's and children's FFQs, space for the child's name as well as the mother's on children's FFQs, and translation of all text on the Spanish versions including the OMB Disclosure Statement. Each FFQ type was coded on the front cover for easy identification and use by project field staff.

3.4 COLLECTION OF FIELD DATA

Field Site Selection

Field sites for the study were selected to provide a diverse geographic and ethnic mix among the study sample. State and Regional WIC offices in New York, California, Texas, and Ohio were asked to provide demographic and client volume data for a number of specific sites. The project identified several possible sites based on these data and submitted them to FNS for review and final selection. After reviewing this information, the final selected sites were:

- Hempstead, New York;
- Oakland, California;
- Houston, Texas; and
- Cincinnati, Ohio.

Initially, it was believed that each of the clinics, with the exception of Cincinnati, Ohio, would be able to provide approximately equal numbers of African-American,

Hispanic and White participants. As a result of the demographic profile of the Cincinnati clinic, the project elected to recruit only African Americans and Whites in Ohio and to increase the Hispanic sample recruited in California, New York and Texas.

As data collection proceeded, it became clear that imbalances in ethnic representation existed among all the sites and in overall recruitment. The Oakland and Houston sites were low in White WIC clients, and virtually no Whites were present at the Hempstead site. The recruitment sample was brought into balance by increasing the target White sample in Ohio. Additionally, two sites in California, one in Berkeley and one in Oakland, were added to the study to improve recruitment of both Whites and Hispanics.

Data Collection

Data collection was conducted from July 21, 1993 until January 28, 1994, a period of 192 days (28 weeks). A total of 969 women and children was recruited with 757 (78.1%) completing all participation requirements. Of these, data from 650 participants (67.1%) were retained for analysis (see Section 4.1 for study population description). Tables 3-2, 3-3 and 3-4 show the recruitment and retention rates for All Participants, for Harvard and for Block participants, respectively. Table 3-5 shows the ethnic distribution of study subjects (those who completed the full participation requirements) by State.

The 212 (21.8%) participants not completing the study either dropped out or were unable to be reached for an initial 24-hour diet recall. Participants who did not qualify for the study or who did not fully complete the first entrance FFQ at the field site, were not counted among "recruited participants" and were not used in the data analysis.

At the six clinic sites, participants were recruited in-person by project field staff. After an initial eligibility screening, qualified participants (women or women reporting for their children) were randomly assigned to complete either the Harvard or Block FFQ (FFQ-1). They were also provided instructions on how to prepare for the 24-hour diet recall interviews and were given a set of two-dimensional food models to take home. Following three successful diet recall interviews by telephone, participants returned to the WIC clinic site approximately one month after being recruited to complete a second FFQ (FFQ-2).

Table 3-2
All Participants Recruited, Completed and Analyzed by Study Category*

Harvard and Block FFQ Groups Combined

	Children		Women: Pregnant		Women: Breastfeeding		Women: Non-breastfeeding		All Women		All Study Participants	
African American												
Recruited	100	100%	84	100%	75	100%	90	100%	249	100%	349	100%
Completed	76	76%	61	73%	65	87%	61	68%	187	75%	263	75%
Analyzed	69	69%	53	63%	54	72%	56	62%	163	65%	232	66%
Hispanic												
Recruited	94	100%	77	100%	83	100%	74	100%	234	100%	328	100%
Completed	72	77%	62	81%	70	84%	48	65%	180	77%	252	77%
Analyzed	59	63%	53	69%	59	71%	43	58%	155	66%	214	65%
White												
Recruited	73	100%	76	100%	64	100%	79	100%	219	100%	292	100%
Completed	61	84%	63	83%	57	89%	61	77%	181	83%	242	83%
Analyzed	53	73%	50	66%	42	66%	59	75%	151	69%	204	70%
All Participants												
Recruited	267	100%	237	100%	222	100%	243	100%	702	100%	969	100%
Completed	209	78%	186	78%	192	86%	170	70%	548	78%	757	78%
Analyzed	181	68%	156	66%	155	70%	158	65%	469	67%	650	67%

* **Recruited** - Participant completed intake interview and first entrance FFQ
Completed - Participant completed entrance and exit FFQs and three diet recalls
Analyzed - Participant data retained in the core data set for analysis

Table 3-3
Participants Recruited, Completed and Analyzed by Study Category*

Harvard FFQ Groups

	Children		Women: Pregnant		Women: Breastfeeding		Women: Non-breastfeeding		All Women		All Study Participants	
African American												
Recruited	50	100%	41	100%	38	100%	41	100%	120	100%	170	100%
Completed	41	82%	29	71%	32	84%	30	73%	91	76%	132	78%
Analyzed	38	76%	26	63%	27	71%	28	68%	81	68%	119	70%
Hispanic												
Recruited	50	100%	37	100%	41	100%	36	100%	114	100%	164	100%
Completed	36	72%	29	78%	36	88%	22	61%	87	76%	123	75%
Analyzed	30	60%	22	59%	31	76%	18	50%	71	62%	101	62%
White												
Recruited	37	100%	36	100%	33	100%	42	100%	111	100%	148	100%
Completed	31	84%	35	97%	27	82%	34	81%	96	86%	127	86%
Analyzed	26	70%	27	75%	23	70%	33	79%	83	75%	109	74%
All Participants												
Recruited	137	100%	114	100%	112	100%	119	100%	345	100%	482	100%
Completed	108	79%	93	82%	95	85%	86	72%	274	79%	382	79%
Analyzed	94	69%	75	66%	81	72%	79	66%	235	68%	329	68%

* **Recruited** - Participant completed intake interview and first entrance FFQ
Completed - Participant completed entrance and exit FFQs and three diet recalls
Analyzed - Participant data retained in the core data set for analysis

Table 3-4
Participants Recruited, Completed and Analyzed by Study Category*

Block FFQ Groups

	Children		Women: Pregnant		Women: Breastfeeding		Women: Non-breastfeeding		All Women		All Study Participants	
African American												
Recruited	50	100%	43	100%	37	100%	49	100%	129	100%	179	100%
Completed	35	70%	32	74%	33	89%	31	63%	96	74%	131	73%
Analyzed	31	62%	27	63%	27	73%	28	57%	82	64%	113	63%
Hispanic												
Recruited	44	100%	40	100%	42	100%	38	100%	120	100%	164	100%
Completed	36	82%	33	83%	34	81%	26	68%	93	78%	129	79%
Analyzed	29	66%	31	78%	28	67%	25	66%	84	70%	113	69%
White												
Recruited	36	100%	40	100%	31	100%	37	100%	108	100%	144	100%
Completed	30	83%	28	70%	30	97%	27	73%	85	79%	115	80%
Analyzed	27	75%	23	58%	19	61%	26	70%	68	63%	95	66%
All Participants												
Recruited	130	100%	123	100%	110	100%	124	100%	357	100%	487	100%
Completed	101	78%	93	76%	97	88%	84	68%	274	77%	375	77%
Analyzed	87	67%	81	66%	74	67%	79	64%	234	66%	321	66%

* **Recruited -** Participant completed intake interview and first entrance FFQ
Completed - Participant completed entrance and exit FFQs and three diet recalls
Analyzed - Participant data retained in the core data set for analysis

Table 3-5
Ethnic Distribution of Study Participants by Site (State)

	California		Ohio		Texas		New York		Total	
African American	133	*51%*	71	*27%*	24	*9%*	35	*13%*	263	*100%*
Hispanic	95	*38%*	0	*0%*	64	*25%*	93	*37%*	252	*100%*
White	56	*23%*	162	*67%*	21	*9%*	3	*1%*	242	*100%*
	284	*38%*	233	*31%*	109	*14%*	131	*17%*	757	*100%*

Recruitment and Training of Field Staff

A field aide was employed at each of the four initial sites. The field aides were responsible for screening and recruiting study participants, administering entrance and exit FFQs, collecting demographic and contact information, record-keeping and reporting. Qualifications for these positions included knowledge of and experience with the WIC program; an understanding of food and nutrition programs; detail orientation; strong interpersonal skills; and an ability to work with WIC staff and diverse clients. Bilingual Spanish/English skills were required for positions in California, New York and Texas.

Recruitment, hiring and training of field staff was conducted sequentially starting in California, followed by Ohio, Texas, and then New York. Considerable difficulty was encountered in locating qualified bilingual candidates in Hempstead and Houston, and extended searches were required.

The field staff were trained over a period of four days immediately following their selection. Standardized field training was conducted at all sites and included a project orientation, training in the administration and scoring of FFQs, review of forms and record

keeping, and an introduction to the WIC clinic study site. Two days of the training were devoted to demonstrating and practicing recruitment and data collection procedures.

Field Methods and Procedures

Field activities included screening and recruitment of participants, administration and manual scoring of FFQs, collection of demographic data at entrance and exit points, and record keeping and reporting. The initial field task required recruiting qualified women and children to participate voluntarily in the study. Field aides worked in available space at the WIC clinics. The study accepted only women or children who were in one of the four WIC-eligible study categories: pregnant women; postpartum, breastfeeding women with babies less than one year old; postpartum, non-breastfeeding women with children less than seven months old; and children, ages 1-4 (reported on by their mother or guardian). Participants were asked to identify themselves or their child as being either African American, Hispanic or White. All qualified participants were required to spend approximately 20 minutes completing an entrance FFQ (FFQ-1), be available to complete three diet recall interviews by telephone, and return to the clinic to complete a second FFQ (FFQ-2) in approximately 4 weeks.

Prior to completing the first FFQ, each participant completed an Intake Form (Appendix C-1) and signed a Consent Form (Appendix C-2). If the woman (or her child) was determined to be eligible to participate, the study subject was assigned a unique identification number and randomly assigned an FFQ type (Block or Harvard). At this time, an appointment for completing a second exit FFQ was agreed upon and written on the consent form. Participants were informed they would receive $30 compensation to cover expenses upon completion of the second FFQ.

Each participant was provided brief instruction for approximately one minute on how to complete the initial FFQ. Upon completion, the FFQ was reviewed for completeness and responses which needed to be clarified. The field aides recorded the amount of assistance required by each participant and the amount of time needed to complete the FFQ. With each participant, field aides reviewed the procedure that would

be involved in completing the 24-hour diet recalls and provided the person two-dimensional food models to take home.

At the conclusion of the third diet recall interview, all participants were reminded of their return appointment. In many instances, the participant was also contacted by the field aide a day or two prior to the scheduled return date. When a study participant returned to complete the second FFQ, the aides would then verify that she had completed the three diet recall interviews. The participant then completed her second FFQ of the same type (Harvard or Block) as completed in the first administration. The field aide completed an Exit Form (Appendix C-3) confirming the participant's study category and mailing address and thanked her for her participation. Participants who completed both FFQs and the three required diet recalls were sent a thank-you letter along with a U.S. Postal money order for $30.

Field Data Collection

Throughout the data collection period weekly status reports of the study sample were compiled based upon the recruitment and completion figures reported by field staff. Weekly review of the sample status permitted control of recruitment within study cells as the project proceeded.

To examine the impact of seasonal differences and food availability on dietary intake, two distinct periods of data collection were defined as Season "A" and Season "B." In the data analysis, results of two time periods were compared: August 1 - September 15 and October 15 - November 30. All data collection was suspended for a four-day period during Thanksgiving and an eleven-day period during the Christmas holiday season. No unusual shifts in dietary intake were observed shortly before or after these holiday periods.

Field Data Collection Problems

Several challenges in field data collection resulted in a one-month-long extension of the overall data collection phase. Data collection in California was briefly delayed during the first month when a field aide had to be replaced. Being located close to the

project office, this posed few problems and a new field aide proved highly productive throughout the remainder of the project. During the second half of data collection, the Texas field aide encountered personal difficulties which affected job performance and resulted in a low participant completion rate. Due to the expense and delay in data collection that would have been required to replace the Texas aide, recruitment of new Houston participants was ended in mid-November. Recruitment of the targeted sample from the Texas site was shifted to other sites.

At all four sites, field staff encountered difficulty recruiting and retaining all categories of Hispanic women, White pregnant women and White postpartum breastfeeding women. To address the recruitment difficulties, recruitment in California, Ohio and New York was continued for an additional six weeks (excluding the two holiday suspension periods). In addition, two new sites were added in California: the Berkeley WIC Clinic in Berkeley; and La Clinica de la Raza in Oakland. The Berkeley clinic served to increase the number of recruited White and Hispanic participants. La Clinica de la Raza assisted with a targeted recruitment of WIC-eligible, postpartum Hispanic women.

A concentrated effort was required at the end of data collection to recruit sufficient numbers of non-breastfeeding postpartum Hispanic women. With approval of La Clinica de la Raza's Board of Directors, this community clinic permitted the project to recruit postpartum Hispanic participants by telephone from the clinic's client records. Recruited participants were offered an additional $10 (a total of $40) to compensate for the expense of two visits to the clinic solely to complete FFQs. This approach proved highly productive and resulted in a sufficient number of Hispanic postpartum women joining the study during the last few weeks of data collection. A similar approach was utilized in Ohio to recruit White participants in the final weeks.

At the end of data collection, the target number of participants had been met or exceeded in all study categories except Hispanic non-breastfeeding women. Of the 118 Hispanic postpartum women completing all requirements, 59.3% were breastfeeding and 40.7% were non-breastfeeding.

3.5 COLLECTION OF REFERENCE DATA

To assess the validity of the FFQs, the FFQ data were compared with a reference data set. The reference data set consisted of three 24-hour diet recalls conducted on non-consecutive days with each participant. Diet recalls were collected by trained nutritionist-interviewers over a period of four weeks, approximately the same time frame asked about during the administration of the second FFQ. Diet recalls were conducted seven days a week by telephone from the Freeman, Sullivan & Co. Computer Assisted Telephone Interviewing (CATI) laboratory in San Francisco, California. Recall data were collected utilizing the Minnesota Nutrition Data System (NDS-32, Version 2.5), software developed and supported by the University of Minnesota Nutrition Coordinating Center.

The Minnesota NDS software was selected for its widely-recognized effectiveness in collecting and analyzing dietary data. This software is based on dietary data collection and nutrient calculation procedures originally developed for the Lipid Research Clinics and the Multiple Risk Factor Intervention Trial. It is being used to collect dietary data in the Third National Health and Nutrition Examination Survey (NHANES III). The NDS database contains over 16,000 foods and 5,000 brand name products and includes many ethnic foods. The database version used for this study contained values for 32 nutrients and 9 nutrient ratios. The NDS nutrient data were derived from USDA, food manufacturers, scientific literature, and foreign food composition tables.

Recruitment and Training of Nutritionist-Interviewers

Nutritionist-interviewers were recruited through university placement centers, university nutrition and dietetic departments and networks of nutrition professionals, and through newspaper advertisements. Qualifications for interviewer positions included being a registered or RD-eligible dietitian, experience conducting 24-hour diet recalls, and experience or familiarity with WIC clinics and their procedures. Eleven nutritionist interviewers were employed with the project, five of whom were bilingual in Spanish and English.

Training of nutritionist-interviewers occurred in three phases. Initially, four interviewers, all registered or RD-eligible dietitians, were trained by the University of Minnesota Nutrition Coordinating Center staff in the use of the NDS-32 software and diet recall interviewing techniques. A second training conducted by these trained nutritionists was held two weeks later for four bilingual staff. Individualized training by project nutritionists occurred for three additional staff added as replacements over the six-month course of data collection.

The group interviewer training lasted three days. The training agenda covered a project overview, an NDS-32 tutorial, review of data entry and editing, methods of nutrient calculation, and interviewing skills. Interviewers also learned data entry procedures, methods of rapid entry, multiple-record calculation, data management and use of the recipe and diet history modules.

Following the initial training, the first interviewer group conducted extensive practice sessions, approximately 20 hours per week for two weeks. The practice sessions consisted of completing diet recalls with each other, company staff members, and with volunteers by telephone. These trial diet recalls were evaluated by senior project staff and in group review sessions. Following the training of bilingual interviewers, a list of Hispanic food equivalents and terms was developed. Interviewers also developed standardized approaches for constructing common Hispanic mixed dishes in NDS. Evaluation and critique of interview methods continued weekly through the first month of data collection.

Diet Recall Data Collection

As participants were recruited at the four field sites, intake forms with entrance demographic data were submitted to the project office. Each participant's demographic information was reviewed, study category and identification number checked for accuracy, and data entered into a study management database. From the database, a "call sheet" was generated for tracking each participant. This sheet included key contact information and space for interviewers to record interview attempts and completions. After each

completed interview, an NDS printout of the diet recall was attached to the call sheet. Call sheets were organized daily into various levels of calling priority.

Collection of three diet recalls was started approximately one week after a participant was recruited. Diet recalls were collected with a minimum of four days between interviews. To gain a representative view of each participant's current diet, the interviewers attempted to collect recalls for one weekend day and two weekdays. Other combinations of days were accepted, but it was considered not acceptable to collect three recalls for weekend days only. Recalls for children in the study were collected from the mother or other guardian who was most familiar with the child's dietary intake.

In rare instances, specific interviews were determined by the interviewer to be "unreliable." If a participant was merely having difficulty reporting on yesterday's diet, the recall was repeated at a later date. If on a first interview, it appeared that a subject would not be able to provide reliable recall information, the participant was dropped from the study. Similarly, if a subject could not be reached by telephone within an initial 10-14 day period, the participant was dropped. Individuals dropped from the study were notified by mail. In general, it was found that participants needed to have a telephone at their residence in order to complete the recalls successfully. Interviewers found it very difficult to contact participants through a neighbor's phone, public phone or shared phone after it was learned that this was the provided telephone number (despite the recruitment requirement instructions).

All problems encountered while conducting recall interviews were recorded in an interview logbook. Problems were then reviewed and resolved by senior project staff. If necessary, problem foods (missing from NDS) or input problems, were referred to the Minnesota Nutrition Coordinating Center for resolution. Several "bugs" and inexplicable error messages were encountered in the NDS-32 software. These were reported to the Nutrition Coordinating Center and solutions successfully found.

Upon completion of a subject's third recall interview, the subject's call sheet and recall printouts were transferred to a completion file. Participants were reminded of their return appointment to complete their exit FFQ. The field aide was then notified of the participant having completed her three recalls.

In all, the project completed 2,654 diet recall interviews. Of these, 2,271 recalls (85.6%) were associated with participants who completed the study and 383 recalls (14.4%) resulted from participants who did not finish or were dropped out of the study. The amount of interviewer time required to contact participants by telephone and complete a recall varied and became more efficient during the course of data collection. Analyzed on a weekly basis, the rate of completed recalls ranged from a low of 0.97 recalls per interviewer hour to a high of 2.25; the average was 1.60 recalls per hour.

3.6 FFQ USABILITY ASSESSMENT

Several regional WIC agencies volunteered to assess the usability of both the Block and Harvard FFQs. Three agencies were selected to participate in this qualitative assessment based upon the diversity of clients served, geographic location and their ability to complete the assessment within the project time frame. The participating WIC agencies included Delaware, North Dakota and Puerto Rico.

Each agency was provided sets of both Block and Harvard FFQs, identified only as "A" and "B" FFQs, for both women and children. They were also given instructions on FFQ administration, manual scoring methods and interpretation of FFQ results. Each agency was asked to use the questionnaires with a small number of WIC clients and to seek qualitative assessments from administering staff as to the FFQs' usability. The assessment was structured around a set of specific evaluation questions provided to each agency. Relative to each area of concern, the agencies were asked to compare the effectiveness of FFQ "A" and "B." Delaware assessed FFQs in both English and Spanish, North Dakota in English only, and Puerto Rico in Spanish only.

3.7 PREPARATION OF DATA

Prior to analysis, all FFQ data were edited for clarity and key entered. FFQ nutrient calculations were made utilizing previously developed software for the Block and Harvard instruments. A master data file was compiled for each participant and included

the demographic data, computed FFQ nutrient values, FFQ manual scores, subfile FFQ editing, data collection observations, and NDS nutrient summary data.

All paper FFQs were edited by project staff prior to key entry. Exit FFQs were marked so that they would be distinguishable from entrance FFQs. A summary label was placed on the cover of each FFQ providing a specific location to transfer an entrance/exit code, assistance score, scoring time, total number of errors, and a participant's FFQ completion time.

Editors reviewed all FFQs for errors and completeness. Food items that were double marked or left blank were coded and counted as an error. On Block questionnaires, if the frequency of a food was marked as "Almost Never" and the amount was blank, it was not coded as an error. All editing decisions were reviewed and verified by senior project staff.

Key Entry of FFQ Data

FFQ data were double-key entered and verified by an outside key entry vendor. Test batches were provided to the vendor and the data entry compared to cleaned data entered in-house. In the test batches entered by the vendor (114 records), there was an error rate of 0.08%, a rate less than the 0.20% rate specified for key entry accuracy. Data entry of the entire FFQ data set was compared to a random sample of records that had been entered and cleaned in-house. The overall key entry error rate was found to be 0.12%, well below the maximum allowable error level.

Calculating FFQ Nutrient Values

Data for both Block and Harvard FFQs were processed using their respective software to calculate estimated nutrient values. The Block FFQ data were processed by Dr. Block using a program which permits "batch" analysis (i.e., processing of multiple records in a single operation). However, the Harvard program, WICENTER, is primarily designed for processing FFQs one at a time. For this study's purposes, a quasi-batch process method was developed for use with WICENTER. It required structuring a data file of multiple records in a dBase format readable by WICENTER and then opening and

closing each FFQ record in "edit mode" causing nutrient values to be calculated and written into the appropriate fields in the dBase file. This was done separately for women and children.

It was confirmed through prior testing that although the WICENTER program for women (ENTERW) performs reliable nutrient calculations, this was not true for the children's program (ENTERC). When the nature of the error was understood, it became possible to produce reliable nutrient calculations using ENTERC. The error found was that in certain instances related to the entry sequence of FFQ records the wrong portion sizes are used by ENTERC. Tests were conducted to insure that the Harvard FFQ nutrient calculations for the children's data used in this validation study were the accurate values intended by the WICENTER designers. (These tests and their results are described in detail in Appendix E-2.)

ENTERC requires a "session date" (the date of data collection) and birth date to calculate age so that different portion sizes can be appropriately applied for children ages 1-2 and ages 3-4. In this study, the recruitment date was used as the "session date" for both the first and second FFQ calculations. This kept each child's age the same for the calculation of nutrient values for both FFQ-1 and FFQ-2. The reported age at the time of recruitment was used for the Block calculations for both FFQ-1 and FFQ-2.

Data Cleaning and Data Quality

In a study such as this, there are numerous sources of error, in both the reference data (the diet recalls) and the test instruments (the food frequency questionnaires). An extraordinary amount of effort was devoted in this study to achieving the best data quality obtainable given the nature of the study population and the data collection methods. Cleaning and editing of the data took place at several levels, and each is addressed separately below. In addition, this process leads to observations about the quality of the data, which are also discussed.

Editing the Diet Recall Data

The reference data in this study consisted of three non-consecutive 24-hour recalls, obtained by telephone over a period of approximately four weeks. To help estimate portion size, study participants used Posner's two-dimensional food models (Posner, 1992). After the diet recall data were collected, extensive editing was conducted to remove or minimize what appeared to be erroneous data. This editing was done completely without knowledge of the participant's FFQ assignment.

During data collection, several steps were taken to insure accuracy. The telephone interviewers were monitored randomly throughout the study by a supervisor and regular weekly meetings were held to discuss problem situations and maintain consistency of interviewing technique. To ensure against data loss, each 24-hour recall was printed and filed by identification number, which also permitted later examination of unusual data. Despite these efforts, some coding errors did take place, as discussed below.

<u>Editing at the Nutrient Level</u>

Prior to preparing the final data set for analysis, nutrient values from vitamin supplements were identified and subtracted from total nutrient values, resulting in food-only nutrient values. Otherwise, no changing of data was done with regard to actual nutrient content assumptions of particular foods. However, an examination of the NDS database suggested that some inappropriate nutrient content assumptions exist in the nutrient data. These may have contributed to misestimations in the recalls and poor correlations or incorrectly high correlations between the FFQs and the recall data. These should be the source of future investigations.

An example serves to illustrate this problem: the calcium content of Kool Aid. Certain extreme outliers in the calcium data led to an examination of particular recalls, and to the discovery that in many cases the source was the supposed calcium content of Kool Aid. For some Kool Aid codes, the NDS system attributes a substantial calcium content; in one respondent, two glasses of Kool Aid supposedly provided 10% of the daily calcium requirement. Nutritionists at Kraft General Foods, however, indicate that there is no calcium in Kool Aid. Discrepancies and possible errors in vitamin C were also noted.

None of these data were changed, but it is likely that there are remaining errors in the recall calcium and vitamin C estimates, particularly although not exclusively within the children's data.

Editing at the Food Level

Because of extreme outliers in vitamin C and calcium, individual food codes used by coders in the recalls were also examined. Kool Aid was again found to be a source of problems. When a subject indicates consuming Kool Aid, the coder must select among a list of Kool Aid codes. The first code on the list refers to the dry Kool Aid powder, rather than the reconstituted beverage. In several cases, the interviewer had selected that code, but had applied the portion size for the reconstituted beverage. In one example this resulted in a vitamin C intake of 4,572 mg. Rather than correcting these codes, the entire recall in which they occurred was deleted. This resulted in the deletion of one of the three recalls for 20 persons, two of the three recalls for two persons, and all recalls for two persons.

Editing at the Single Recall Level

Quite often, individual nutrient estimates derived from the 24-hour recalls and two-dimensional models were improbably high, values such as 300 mg of protein, or 700 mg of vitamin C from food. Consequently, a major editing activity involved examining the nutrient estimates from an individual's set of three recalls, and deleting recalls in which the estimate for one of the days was extremely different from that individual's other days.

There are two rationales for this approach. First, why delete the entire recall rather than attempting to correct the erroneous data? It was often not clear where the error was, whether in the choice of food code, choice of portion size model, or several errors in several foods. The correct answer was unknown. Thus, any actual 'correcting' of the individual respondent's data was inappropriate.

Second, why examine an individual's 24-hour recall in comparison with that individual's other two recalls, rather than simply excluding persons who were outliers on nutrients overall? A particular nutrient value in a diet recall might not be unusually high

for the population, and would not be detected as an outlier; but when viewed in comparison with a subject's other recalls, it could be seen that a particular value was suspect for that individual. For example, while 100 mg of protein for a child in a day would not have been defined as an outlier for the population as a whole, the child's other two days' values of 28 mg and 31 mg made it appear to be extremely unlikely for that individual. Examination of a large sample of actual recalls led to the development of decision rules with which to attempt to differentiate consistently and systematically between probably erroneous recalls and recalls that were legitimately high. These decision rules are shown in Appendix E-3.

As a result of the edits at this individual recall level, 153 of the 757 remaining study subjects had fewer than three recalls; 132 had two recalls remaining, 19 had only one recall, and 2 records were completely dropped because they had no recalls surviving this editing process. The recall average nutrient estimate was calculated using the appropriate denominator (one, two or three) for these individuals.

Editing at the Average Nutrient Level

After editing the recall data at the individual 24-hour recall level, some extreme outliers remained even for the nutrient estimates based upon the average of the individual's three (or fewer) days. To examine this distribution, stem and leaf plots were displayed, for women and children separately, for each nutrient. An example of this is shown for protein for women in Figure 3-2.

It can be seen that for 17 women, the average daily intake of protein was estimated to be above 160 g. For comparison, the median in NHANES II one-day data for low-income women in this age range was 55 g and the 95th percentile was 113 g. These high values were flagged by the statistical software program and represent values that are more than two standard deviations above the mean. For consistency across all women and all children, all such flagged outliers were dropped from further analysis, representing 14% of the retained women and 13% of the retained children. The study subject was dropped, rather than just the individual's particular nutrient, because erroneously high values had implications for other nutrients (protein and iron, for example), and severe overestimates

Figure 3-2

Example of Stem-and-Leaf Plot for Recall Protein (Women)

```
    MPROTEIN  Mean Recall Protein (Aver

Valid cases:        546.0   Missing cases:         .0   Percent missing:      .0


Mean        85.3452  Std Err     1.4018  Min        18.4550  Skewness     1.1475
Median      80.5350  Variance  1072.966  Max       258.7850  S E Skew      .1045
5% Trim     83.3517  Std Dev    32.7562  Range     240.3300  Kurtosis     2.6008
95% CI for Mean (82.5916, 88.0989)       IQR        38.6683  S E Kurt      .2087


Frequency    Stem &  Leaf

     1.00        1 .  &
     3.00        2 .  8&
    20.00        3 .  12446678&
    33.00        4 .  12334455678899&
    63.00        5 .  00001112222334444556666788899
    67.00        6 .  0001122233344455667778888999999
    81.00        7 .  0000011111122233444445556667778888999
    72.00        8 .  0000111222334555566667778888889999
    68.00        9 .  0000112222333334455556677888888999
    32.00       10 .  11233445558888&&
    34.00       11 .  011223466688&
    24.00       12 .  0122445789&
    16.00       13 .  1689&&&
     9.00       14 .  569&
     6.00       15 .  1&
    10.00 Extremes    (161), (162), (163), (166), (167), (167), (168), (173)
     7.00 Extremes    (177), (190), (199), (206), (221), (232), (259)

Stem width:     10.00
Each leaf:       2 case(s)


& denotes fractional leaves.
```

suggested a possible pattern of inaccurate reporting. Unless specifically noted, all analyses presented were performed on the core data set of 650 study subjects for whom each of the recalls used were judged to be reliable.

The three-day mean nutrient levels that caused study subjects to be dropped as outliers are shown in Table 3-6, together with comparative data from national surveys. The NHANES II data are based on a single 24-hour recall and would normally have a wider distribution, and therefore a higher 95th percentile, than would data from three days such as were collected in this study. The data are for women 18-24 and male children 1-2,

Table 3-6

Applied Nutrient Cutpoints for Identifying Recall Outliers Compared with National Survey Data

	Recall Cutpoints Applied in Study	NHANES II 95th Percentile	CSFII 90th Percentile
Women			
Energy (kcal)	4,260	2,877	2,172
Protein (g)	160	113	91.3
Vitamin A (RE)	2,607	—	1,498
Vitamin C (mg)	359	290	124
Iron (mg)	31.5	20.3	15.5
Calcium (mg)	2,115	1,511	1,093
Children			
Energy (kcal)	2,541	2,156	1,989
Protein (g)	103	91	79.6
Vitamin A (RE)	1,556	—	1,386
Vitamin C (mg)	217	237	136
Iron (mg)	21.5	19.7	15.7
Calcium (mg)	1,616	1,706	1,235

below the poverty level. The CSFII data are for the low-income CSFII study and are based on the average of four days of data; consequently, the distributions should be similar to the present study.

It can be seen from Table 3-6 that in most cases the "outlier" criteria, which were derived from the actual data distribution, were fairly generous. The energy cutpoint for women of 4,260 kcal was almost 1,400 kcal higher than the NHANES II 95th percentile. The calcium cutpoint was 600 mg higher than the NHANES II 95th percentile. The other cutpoints for women seem similarly justifiable as levels above which the data may represent inaccurate reporting. For calcium and vitamin C in children, however, it may be that some who were excluded did have legitimately high values. On the other hand, it should also be noted that erroneously high values can occur in the NHANES II data, as

well. It might even have been valuable to apply still lower cutpoints, perhaps defined as two standard deviations above the CSFII four-day mean if CSFII standard deviations data had been readily available. However, the approach shown below, based on conventionally defined extremes, appeared justifiable after detailed examination of the actual study subjects' recalls.

It should also be noted that the exclusion criteria for the recall data involved identifying cases in which the whole day's nutrient estimate was extreme. Thus there are undoubtedly estimates for an individual food that are incorrect, but that did not cause the whole day to be extreme, and thus are not detected. Such estimates would nevertheless cause misestimates of that individual's intake. Furthermore, it should be noted that the resulting data set still contains high values, such as a three-day average protein estimate of 150 mg, that fell within the selected cutpoint, but may be of questionable accuracy.

These editing procedures in the recalls left 650 study subjects in the core data set for analysis. In the results tables of Section 4, this is what is referred to as "No FFQs Dropped" or "All Cases Included," that is, the FFQ outliers are included, but questionable recall data are not a part of this core data set.

Usefulness of the Recall Editing Procedures

Poor correlations between FFQs and recall data can result not only from failures in the FFQs, but also from errors in the recall data. The editing procedures above were an attempt to improve the quality of the reference data, by removing probably erroneous data, and thereby provide the clearest test of the FFQs. To test whether these extensive edits were in fact justified, the correlations shown in Section 4.3 were rerun after adding back all of the *recalls* and *individuals* that had been dropped due to the editing decisions. The resulting correlations were in fact slightly lower for most comparisons, suggesting that the editing procedures had, in fact, been successful in identifying at least some of the erroneous data. As discussed below under "Data Quality Issues," it is likely that questionable data still exist in the recall data set.

Editing the FFQ Data

Visual editing of the food frequency questionnaires took place immediately upon their completion. The aide at each site examined them for omissions, double marks and suspicious data (e.g., many high frequencies or many "nevers"). These were clarified with the respondent immediately and the correct response recorded. Computerized editing to identify questionable data in the food frequency questionnaires was performed according to the methods of the respective authors.

For the Harvard FFQ, the only exclusion criterion for questionable data was related to the total energy estimate: FFQ energy estimates that exceed 4,500 kcal were considered suspect. All such responses were excluded from analyses labeled "Outlier FFQs dropped." All FFQ data, including those exceeding 4,500 kcal, were included in analyses labeled "No FFQs Dropped." For children, no Harvard exclusion criteria had been identified. To identify an exclusion level for children comparable to Harvard's prior rule for women, the standard deviation reflected by 4,500 kcal was identified in the women's data. The same standard deviation was applied to the children's data (on normalized values). The cutpoint for Harvard children, identified in this way, was 3,100 kcal. Thirteen percent of Harvard women and 13% of Harvard children were excluded by these criteria.

For the Block FFQ, the exclusion criteria were related not to total energy intake, but to identifiable errors in responses. The criteria used for this analysis were the default edit criteria in the software, as follows: skipped more than 15% of the food items; omitted portion size on 100% of food items or answered "medium" to 100% of the food items; total number of solid food items added up to fewer than four solid foods per day, or more than 30; three or more different food items had frequency responses that exceeded predefined "reasonable" frequencies. Eleven percent of Block women and 7% of Block children were flagged as having questionable data by these criteria. These are the study subjects excluded from analyses labeled "Outlier FFQs Dropped," although they are not strictly outliers but are questionable for other reasons.

Editing of the FFQ Manual Scores

The manual scoring performed by the field aides was reviewed centrally and corrected, if necessary, prior to data entry.

Data Quality Issues

Recall Data -- Portion Size Estimation

As can be seen from the description of the data collection methods and the data editing methods above, attention was paid to obtaining the highest quality data for this study. Nevertheless, it appears likely that errors in the reference data still remain. Use of the Posner two-dimension models to estimate portion size may have been difficult for this population. It appears very difficult to relate the two-dimensional drawing of various bowls, for example, to actual three-dimensional bowls. Of the two bowl sizes shown, one is clearly larger than the other, but it may not be clear that the larger one actually holds two cups. Estimating two cups instead of one cup for fortified breakfast cereal, for example, can produce severe overestimates of micronutrients. The smallest glass shown is intended to represent a shot glass, and is rated at only 1.5 ounces. However, it could be, and apparently sometimes was, mistaken for a small four-ounce juice glass. Differences among the three sizes of spoons are difficult to distinguish, but their rated amounts range from two teaspoons to 1.8 tablespoons (no spoon represents one teaspoon). Similar difficulties appear to exist for all the drawings.

It appeared from examination of the recall data that in some cases substantial overestimates of portion size took place. Underestimates may also have taken place, for example in thickness of slices of meat. However, overestimates appear to be more common. This is supported by the mean values seen in this study. After the exclusions described above, the mean energy intakes for pregnant, breastfeeding and non-breastfeeding women (2,120, 2,020 and 1,830 kcal, respectively) are each 250-300 kcal higher than the comparable group of pregnant, lactating or non-lactating women in the 1985-86 CSFII data. That is true regardless of whether one examines the CSFII data for Whites or African Americans, above or below poverty (Murphy, 1993).

The difficulty of estimating portion size has been the subject of considerable research (Guthrie et al., 1984). Recently some very relevant research was conducted by Kuehneman et al. (1994). These investigators asked caregivers of young children to estimate portion sizes of foods consumed by their children, using three methods: graduated food models, Nasco plastic food models, or food pictures. In a fourth approach, standard portions were assigned to each food by the investigators. The caregivers then collected weighed duplicate 24-hour intakes monthly for one year. Each of the four portion size estimates were then compared with the actual weighed portion size consumed for 38 food items. The standard serving sizes produced many fewer misestimates of the portion size actually consumed than did any of the three visual models used by the caregivers. Using the food pictures, the portion size was correctly estimated for only six of the 38 foods. In contrast, 17 of the 38 were accurate when the standard portion was used. Most misestimates were in the direction of overestimates; 31 of the 38 food items were overestimated by the caregivers using the food pictures.

In summary, it is likely that considerable portion size misestimates and overestimates existed prior to editing and that many still remain but are not detectable.

Recall Data - Respondent Characteristics

The subjects in this study included low-income Hispanic, African-American and White women. Educational level was moderate, particularly among Hispanic women (see Section 4.1). Lack of familiarity with the kind of thinking required to remember foods and estimate portion sizes may have been a factor in this population.

Recall Data - Database or Data Collection Problems

As noted above, there may be inappropriate nutrient content or quantification assumptions in the NDS database, of which the calcium content of Kool Aid is an example. Another important data collection problem became apparent in this study, involving the collection of recall data from Hispanics, because of the very large number of mixed dishes in the typical Hispanic diet. Approximately 80% of the Hispanic women in the study chose to complete the FFQs in Spanish, suggesting a close acculturation to the

Hispanic diet. The Hispanic diets involve mixed dishes to a very large extent. Even if named mixed dishes exist on the database, their composition may differ from one ethnic subgroup to another. And often the dishes may not have a particular name, such as "menudo," but are simply individual mixed dishes. In this study, the interviewer obtained the recipe, including exact amounts not only of individual foods but of liquid, and more importantly, ascertained how much of that recipe was consumed by the subject. This is inevitably an error-prone process both on the part of the person reporting the amounts and the interviewer recording the amount consumed. It is possible that this error was one source of the poorer results seen in the correlations for Hispanics (see Section 4.3).

Corresponding Errors in Recall and FFQ Data

As illustrated in the correlation results (see Section 4.3), a single respondent whose FFQ estimate differs notably from the recall estimate can, under some circumstances, dramatically reduce the correlation coefficient for the whole group. However, it is also possible to artificially inflate the observed correlation. This inflation can occur when some study subjects commit similar errors on both the FFQ and reference data. To prevent this type of error, validation studies are performed using two different types of data collection, recalls or records for the reference data, and food frequency questionnaires for the test data. However, it appears possible that in the present study corresponding or correlated overestimation errors in reference data and FFQ data may have produced some exaggerated correlations. It may also be an explanation for the lower correlations seen when the FFQ outliers were excluded from the analyses.

Final Data Set Preparation

The 24-hour recall data from all participants were converted to nutrient values using NDS-32 software. Two NDS recall data sets were created. One contained detailed breakdowns of daily food intake for each subject for each of the three recalls. The other data set contained the totaled daily intakes for each subject for each recall and the three-day averages for the nutrients of interest. The final data set consisted of 757 acceptable cases with three recalls per case. Demographic data and Block and Harvard FFQ data

consisting of computer scores, manual scores and food group scores were merged with the NDS data. When all questionable recall data were eliminated from analysis, the resulting subset of the data contained 650 cases (see Section 4.1, Description of Study Population).

3.8 ANALYSIS

The analyses were performed using SPSS for Windows (Statistical Package for the Social Sciences), Release 6.0 (Norušis, 1993). Analyses ranged from simple summary statistics and frequency distributions through factorial analyses of variance designs with simple effects tests. Stem and leaf plots and scatter plots were used to identify extreme values. Pearson's chi-square statistics and both Pearson Product Moment and Spearman correlations were conducted. Repeated measures analysis of variance between- and within-group were performed using the Biomedical Data Package (BMDP) Dynamic, Release 7.0 (Dixon, 1992), to provide estimates of between- and within-group variance components used in the correction for attenuation of correlation coefficients due to measurement error in the reference data.

Bivariate normal data are required to satisfy the assumptions of the Pearson correlation coefficient. Pearson was chosen for the main analyses over the non-parametric Spearman approach for purposes of performing adjustments for measurement error. Both FFQ and diet recall data were first examined for skewness and normality. If they were skewed or non-normal, as most were, a transformation was applied. This was done as a separate process for each instrument (Harvard, Block); for the first and second administrations of the questionnaire (FFQ-1, FFQ-2); for all subjects in the analyzed core data set and for the subset who were not "FFQ outliers;" for all children; all women; for each ethnic group; and for each WIC category (pregnant, breastfeeding, non-breastfeeding); and the respective recall data for each of the above groups. Each of these groups was then transformed using the transformation that best reduced the skewness and improved the normality. Log transformation, square root transformation, and in a few cases no transformation, were used. This approach successfully normalized the data.

Log transformation is sometimes not the best transformation to normalize and reduce skewness. Indeed, log transformation may often increase the skewness or non-normality of the data. Explorations in the present study revealed that correlations were sometimes higher when log transformation was used compared with the optimal transformation. However, since the purpose of the present study was not to obtain the best correlation but the best estimate of the true correlation, log transformation was not used unless it was the transformation that produced the most normal, least skewed data.

Spearman (non-parametric) correlations are presented in these results for some analyses. The Spearman approach produces correlations closely similar to Pearson correlations when Pearson correlations have been performed on normalized data. Consequently, Spearman correlations are used when subgroup comparisons are being examined, since they do not require the tedious re-normalization of each new subgroup. However, for the main set of correlations in which it was desired to perform adjustments for measurement error, Pearson correlations with appropriate transformations were used.

SECTION 4 - RESULTS

4.1 DESCRIPTION OF STUDY POPULATION

Analytic Approach

A total of 969 women was recruited to participate in the study. Of these, 757 "completed their obligation" by providing all three days of diet recalls and two FFQs. This "completed" sample of 757 was then reduced to 650 as a result of extensive edits performed on the reference data (the 24-hour diet recalls). The resulting 650 study subjects constitute the core or "analyzed" data set. All analyses were performed on this core data set. This section describes the demographic characteristics of the core data set, and demonstrates that there was balance between the Harvard and Block FFQs on the relevant demographic characteristics.

Balance Between Harvard and Block

Table 4-1 shows the distribution of relevant characteristics of the population, by FFQ type. It can be seen that balance was achieved between Harvard and Block on all variables that were measured. The difference in education by ethnicity is notable. For women and women reporting for a child, approximately one-third of Hispanic participants reported having eight years of education or less. For African Americans and Whites, less than 3% reported at this level. A more detailed education distribution by ethnicity is presented in Table 4-2.

Balance was also achieved with the diet recall data for the nutrients of interest between the Harvard and Block women (see Table 4-3). Mean nutrient intake was also comparable between the Harvard and Block children with the exception of the Block children having a significantly higher mean protein intake in both the completed and analyzed data and a slightly higher calcium intake in the analyzed data ($p = .06$). Analysis of variance did detect significant differences in nutrient intake by ethnic group and WIC category, as can be seen by examining Tables 4-8 through 4-14.

Table 4-1
Demographic Characteristics (Completed and Analyzed) by FFQ Type

	Completed n = 757			Analyzed n = 650		
	Harvard	Block	Significance	Harvard	Block	Significance
	n = 382	*n* = 375		*n* = 329	*n* = 321	
Ethnicity *						
African American	91	96	ns	81	82	ns
Hispanic	87	93	ns	71	84	ns
White	96	85	ns	83	68	ns
Category						
Pregnant	93	93	ns	75	81	ns
Breastfeeding	95	97	ns	81	74	ns
Non-breastfeeding	86	84	ns	79	79	ns
Child	108	101		94	87	ns
Mean Age at Entry						
Women	25.3	25.7	ns	24.9	25.4	ns
Children	2.4	2.5	ns	2.4	2.5	ns
Previously on WIC in Last 4 Weeks**						
No	32.5%	30.5%	ns	32.6%	30.6%	ns
Yes	67.5%	69.5%	ns	67.4%	69.4%	ns
Language Selected Among Hispanics*						
Spanish	80.5%	82.8%	ns	80.3%	81.0%	ns
English	19.5%	17.2%	ns	19.7%	19.0%	ns
Education***						
African American			ns			ns
0-8 Years	0.0%	1.2%		0.0%	0.0%	
9-12 Years	54.4%	53.3%		58.8%	52.6%	
13+ Years	45.6%	45.5%		41.3%	47.3%	
Hispanic			ns			ns
0-8 Years	35.6%	33.7%		35.2%	36.1%	
9-12 Years	54.0%	55.4%		56.3%	55.4%	
13+ Years	10.3%	10.9%		8.4%	8.4%	
White			ns			ns
0-8 Years	2.1%	0.0%		2.4%	0.0%	
9-12 Years	58.9%	61.0%		59.8%	66.7%	
13+ Years	39.0%	39.0%		37.8%	33.3%	

ns = not significant
* *women participants only; excludes children*
** *all women and children participants*
*** *women participants and women reporting for a child*

Table 4-2
Educational Levels (Completed and Analyzed) by Ethnicity

	Completed *n = 757*			Analyzed *n = 650*		
	African American	Hispanic	White	African American	Hispanic	White
Years of Education*	*n = 263*	*n = 252*	*n = 242*	*n = 232*	*n = 214*	*n = 204*
0	0.0%	1.1%	0.0%	0.0%	1.3%	0.0%
1-5	0.0%	10.0%	0.0%	0.0%	11.0%	0.0%
6	0.0%	16.8%	0.0%	0.0%	16.2%	0.0%
7-8	0.6%	6.7%	1.1%	0.0%	7.1%	1.4%
9	2.2%	17.9%	4.0%	2.6%	19.5%	2.0%
10-11	16.1%	15.0%	14.7%	16.7%	14.3%	14.9%
12	35.6%	21.8%	41.2%	36.5%	22.1%	45.9%
13-14	28.9%	5.6%	23.2%	28.2%	5.1%	22.3%
15-16	12.8%	2.8%	11.3%	13.5%	2.5%	10.8%
17+	3.9%	2.2%	4.5%	2.6%	0.6%	2.7%

* *women participants and women reporting for a child*

Table 4-3
Mean Nutrient Intake (Completed and Analyzed) by FFQ Type

	Completed *n* = 757			Analyzed *n* = 650		
	Harvard	Block	*Significance*	Harvard	Block	*Significance*
Mean Nutrient Intake by Recall Data						
Women	*n* = 274	*n* = 274		*n* = 235	*n* = 234	
Energy (kcal)	2,210	2,203	*ns*	1,994	1,994	*ns*
Protein (g)	89.8	89.1	*ns*	79.6	79.6	*ns*
Vitamin A (RE)	1,293	1,217	*ns*	882	896	*ns*
Vitamin C (mg)	198	161	*ns*	125	117	*ns*
Iron (mg)	17.3	17.3	*ns*	14.5	14.3	*ns*
Calcium (mg)	1,059	1,030	*ns*	876	893	*ns*
Children	*n* = 108	*n* = 101		*n* = 94	*n* = 87	
Energy (kcal)	1,334	1,454	*ns*	1,259	1,344	*ns*
Protein (g)	50.6	57.1	$p < .01$	47.5	52.0	$p = .04$
Vitamin A (RE)	753	702	*ns*	636	600	*ns*
Vitamin C (mg)	125	160	*ns*	76	81	*ns*
Iron (mg)	11.7	11.4	*ns*	10.2	10.3	*ns*
Calcium (mg)	888	893	*ns*	682	756	*ns*

ns = not significant

4.2 FFQ ASSISTANCE SCORES, ERRORS, COMPLETION TIME, AND SCORING TIME

Analytic Approach

The Harvard and Block FFQs were compared with respect to the following factors that might affect the usability of the instruments by either study subjects or WIC personnel:

- Amount of assistance needed by the respondent to complete the FFQ;
- Number of errors on the FFQ, as identified by manual and computer edit procedures;
- Time required by study subjects to complete the FFQ; and
- Time required by aides to manually score the FFQ.

The level of assistance study subjects required was scored as follows:

Score	Description
1 = None	Required neither clarifications nor explanations and no additional assistance after the initial instructions
2 = Little	Required 1-2 clarifications but no explanations
3 = Some	Required 3-5 clarifications and 1-2 explanations
4 = Much	Required 3 or more explanations.

Discussion

Assistance Required

The first administration of the FFQs was considered to be the most relevant to the WIC situation. Average scores are provided for this administration only. Most study subjects required relatively little assistance in completing either FFQ. The average score was less than 2, meaning that, in general, study subjects needed little assistance from the field aides (see Table 4-4). There was no difference between Harvard and Block on this variable, by Analysis of Variance. There were, however, significant ethnic differences, with White women requiring somewhat less assistance than African-American or Hispanic

women. Although significant, the differences did not appear to be very important (mean score of 1.5 *vs.* 2.0, for example). Overall, women completing FFQs for their children's diets had a slightly higher assistance score, mean = 2.0 instead of 1.8.

Errors by Respondent

Manual edits identified missing responses or double-marks. For these edits, an error was counted in three fields (frequency, portion size and vitamin supplement) for the Block FFQ, and one field (frequency) for the Harvard FFQ. Number of errors was totaled for the first administration of the questionnaire only. These unadjusted counts (Table 4-5) show statistically significant differences between Harvard and Block in mean number of errors committed. For All Women, the median number of errors was 2.0 for both Harvard and Block, but the mean was higher for the Block FFQ (7.3 *vs.* 4.6). For most groups the median number of errors was modest, indicating that most people skipped or double-marked few or no food items. Hispanic women, however, were substantially more error-prone than the other groups, a difference statistically significant by analysis of variance. Women completing the FFQs for their children had a higher error rate by this measure, mean = 7.9 instead of 6.0 (data not shown).

The unadjusted error counts do not provide a direct comparison between Harvard and Block for two reasons. The error proneness of Harvard compared to Block is exaggerated because the Harvard list includes more line items on which a respondent could make an error. The Harvard food list has 80 items while there are only 65 on the Block list (62 for children). Conversely, the errors on Block compared to Harvard are exaggerated because omissions on the Block questionnaire were counted in three fields compared to one field for the Harvard questionnaire. Omissions of some portion size responses on the Block FFQ are unimportant, either because portion size is not required if the person does not eat the food, or because the Block computer software will automatically default to a "medium" portion size. An examination of a sample of Block questionnaires suggested that approximately one-third of all errors were actually omissions or double-marks in the frequency field. (Further, approximately one-third of those were found upon query to be foods the respondent never ate, and thus their omission would

Table 4-4

Assistance Required by Women Participants by All Women, Ethnicity and Children

Average Scores, where: 1 = None; 2 = Little; 3 = Some; 4 = Much

		Harvard	Block
All Women *			
	mean	1.8	1.9
	SD	1.0	1.1
	(n)	(253)	(241)
African American			
	mean	2.0	2.1
	SD	1.1	1.2
	(n)	(85)	(92)
Hispanic			
	mean	1.9	2.0
	SD	0.9	1.2
	(n)	(72)	(68)
White			
	mean	1.5	1.6
	SD	0.9	0.9
	(n)	(96)	(81)
Children			
	mean	1.9	2.0
	SD	1.1	1.1
	(n)	(103)	(91)

* Difference between FFQ types is not significant ($p = 0.36$), difference among ethnic groups is significant, $p < 0.01$ (ANOVA).

Table 4-5

Number of Errors Identified by Manual Edit by All Women and Ethnicity

Includes missing or double-marked responses for portion size, frequency or vitamin supplement fields

		Harvard	Block
All Women *	*median*	**2.0**	**2.0**
	mean	4.6	7.3
	SD	9.9	14.0
	(n)	(273)	(273)
African American	*median*	**2.0**	**3.0**
	mean	4.9	7.7
	SD	9.2	16.2
	(n)	(90)	(96)
Hispanic	*median*	**4.0**	**4.0**
	mean	6.0	10.8
	SD	8.7	15.8
	(n)	(87)	(92)
White	*median*	**0.0**	**1.0**
	mean	3.1	3.1
	SD	11.3	6.1
	(n)	(96)	(85)

* Statistically significant effects by both FFQ type, $p < 0.02$, and ethnicity, $p < 0.01$ (Analysis of Variance).

have no effect on the nutrient estimates.) Adjustment of the error scores of the two instruments to account for the "overcounting" in each direction suggests that there is no difference between the instruments in the number of relevant items that study subjects omitted or double-counted.

A computerized edit of omitted or double-marked food frequency items remaining after the FFQs were examined by the aides found 17% of Harvard women's FFQs-1 had one or more skipped items remaining, and 9% of Block women's FFQs-1 had one or more skipped items remaining. None of the FFQs had more than a few missed items, and neither instrument had a sufficiently large number of remaining skipped or double-marked items to be considered a serious source of error.

Time for Study Subjects to Complete the FFQs

This is shown only for the second administration (FFQ-2), since few study subjects were timed during the first administration due to the logistic complexities of the first phase. Table 4-6 shows that both types of FFQs were completed in less than 10 minutes by both African-American and White study subjects, and in less than 15 minutes by Hispanic study subjects. Study subjects took longer to complete the Block FFQ than the Harvard FFQ with a median time of 9.5 minutes for Block *vs.* 8 minutes for Harvard for All Women (means of 11.0 *vs.* 8.6 minutes). Both the FFQ type and ethnic differences were statistically significant by Analysis of Variance. Completion time for mothers responding for their children was similar to All Women (data not shown), but the numbers were too small to derive any firm conclusions.

Time for Aide to Manually Score the FFQs

There were no significant differences between Harvard and Block in the time required for scoring (Table 4-7). The median time was three minutes for both instruments at both time periods. Between the first and second time periods (FFQ-1 and FFQ-2), the additional practice resulted in a lower scoring time for both FFQs. The improvement was slightly greater for the Harvard manual scoring, from a mean of 3.9 minutes for FFQ-1 to 3.2 minutes for FFQ-2. The Harvard scoring system possibly was somewhat intimidating

or confusing to aides at first, but with familiarity, it became very rapid and easier to score than Block. The reason may be due to the mental mathematical additions required of the Block scoring system. Aides took slightly longer to score children's FFQs (mean 3.6 minutes for FFQ-2 instead of 3.3 minutes for women's FFQs; data not shown).

As would be expected, the amount of assistance required, number of errors committed and aides' scoring time were reduced at the second administration of the FFQs.

Table 4-6

Time for Respondent to Complete FFQ-2 by All Women and Ethnicity

(in minutes)

		Harvard	Block
All Women *	*median*	**8.0**	**9.5**
	mean	8.6	11.0
	SD	3.4	5.0
	(n)	(61)	(58)
African American	*median*	**8.0**	**9.0**
	mean	8.5	8.9
	SD	3.1	2.3
	(n)	(20)	(17)
Hispanic	*median*	**10.5**	**13.5**
	mean	10.3	14.6
	SD	3.9	6.0
	(n)	(24)	(22)
White	*median*	**6.0**	**8.0**
	mean	6.4	8.5
	SD	1.0	2.7
	(n)	(17)	(19)

* Statistically significant effects by both FFQ type and ethnicity, Analysis of Variance $p < 0.01$

Table 4-7

Time to Score FFQ-1 and FFQ-2 by Type of FFQ

(in minutes)

		Harvard	Block
FFQ-1 *	*median*	**3.0**	**3.0**
	mean	3.9	3.8
	SD	2.0	1.5
	(n)	(266)	(259)
FFQ-2	*median*	**3.0**	**3.0**
	mean	3.2	3.4
	SD	0.9	1.0
	(n)	(236)	(234)

* By ANOVA, a significant ethnicity effect exists for FFQ-1 ($p<0.01$) and FFQ-2 ($p<0.05$) controlling for Harvard, Block instrument types. The effect is greatest for Hispanic FFQs, with the highest score time, followed by African-American then by White FFQs.

4.3 FFQ VALIDITY CORRELATIONS

Analytic Approach

A central purpose of FFQs, both for research and for WIC purposes, is to place individuals along a distribution of intake from low to high. Accuracy of the point estimates (group means), while useful for some purposes, provides no test whatsoever of the ability of an instrument to determine correctly whether an individual's intake is high or low. FFQ group means can be identical to diet recall group means despite providing zero ability to rank individuals; and conversely, FFQ group means can be significantly lower than diet recall means, but the FFQ can rank individuals well (Sobell 1989, Stuff 1983). To be relevant for estimating whether an individual is at increased nutritional risk, a proposed FFQ must produce adequate correlations with reference data. It is correlation that forms the criterion for whether an instrument can provide a reasonably accurate estimate of an individual's location along the distribution from low to high intake.

This section presents the correlations between the FFQ nutrient estimates and the reference data estimated from three non-consecutive days of diet recalls. Data are presented only for nutrients from food; mineral and vitamin supplement intake is not included.

The correlations for the core analyzed data (n = 650) with no nutrient/energy outlier FFQs excluded and for the subset of cases with FFQ outliers excluded are shown for the first and second FFQ administration separately. These data are shown, unadjusted, in Tables 4-8 (for FFQ-1) and 4-9 (for FFQ-2).

Adjustments to account for error in the reference data, the diet recalls, were performed according to the method described by Beaton (1979), Liu (1978), Rosner (1988). The dietary intake based on three days does not perfectly reflect "true" usual intake over a longer period, because of day-to-day variability. Consequently, any correlation between this imperfect measure of intake and a food frequency questionnaire is an underestimate of the true correlation. However, the intraindividual variability in intake and its relationship to interindividual variability can be quantified by means of analysis of variance of the three diet recalls, and the results used to adjust the observed correlations. The adjustment factors, when applied to the observed correlations, result in the adjusted correlations being higher than the unadjusted correlations. These adjusted correlations are shown in Appendix D, Tables D-1 (for FFQ-1) and D-2 (for FFQ-2). These adjusted correlations are not emphasized in the discussion because they are themselves estimates based on imperfect data. They do not alter any conclusions about the relative value of the two FFQs. They do provide a general sense of the magnitude of the improvement which might have been seen had "all" days of dietary reference data been collected, instead of only three days.

Statistical Significance

The statistical significance of a correlation coefficient (that is, whether or not it is significantly different from zero) is simply a function of the sample size. For the All Women analyses, correlations as low as $r = 0.13$ will be significant at the $p < 0.05$ level. For other subgroups (pregnant, Hispanic, etc.), correlations as low as approximately $r = 0.22$ will be significant at the 0.05 level. Significance is not emphasized because it is self-evident from the above data, and it tells little about the usefulness of the relationship. For purposes of this

Table 4-8 Validity Coefficients for Harvard and Block FFQ-1

		All Cases Included		Outliers Dropped	
		Harvard	Block	Harvard	Block
African American	Energy	0.18	0.53	0.12	0.37
	Protein	0.22	0.46	0.08	0.35
	Vitamin A	0.00	0.28	0.01	0.13
	Vitamin C	-0.36	0.32	-0.23	0.29
	Iron	0.02	0.40	0.02	0.20
	Calcium	0.27	0.46	0.38	0.40
Hispanic	Energy	0.19	0.14	0.08	0.07
	Protein	0.13	0.09	0.10	0.00
	Vitamin A	0.40	0.15	0.40	0.24
	Vitamin C	0.28	0.17	0.18	0.14
	Iron	0.28	-0.01	-0.03	-0.13
	Calcium	0.18	0.15	0.13	0.17
White	Energy	0.27	0.44	0.29	0.48
	Protein	0.33	0.53	0.38	0.55
	Vitamin A	0.28	0.62	0.30	0.55
	Vitamin C	0.33	0.20	0.31	0.13
	Iron	0.27	0.47	0.32	0.40
	Calcium	0.40	0.56	0.43	0.51
All Women	Energy	0.19	0.37	0.16	0.31
	Protein	0.24	0.35	0.21	0.27
	Vitamin A	0.21	0.32	0.18	0.26
	Vitamin C	0.13	0.30	0.12	0.24
	Iron	0.20	0.26	0.11	0.12
	Calcium	0.29	0.42	0.34	0.36
Pregnant	Energy	0.22	0.30	0.20	0.21
	Protein	0.29	0.32	0.24	0.28
	Vitamin A	0.29	0.26	0.29	0.20
	Vitamin C	0.12	0.18	0.08	0.11
	Iron	0.32	0.05	0.31	-0.07
	Calcium	0.41	0.37	0.47	0.28
Breastfeeding	Energy	0.23	0.25	0.13	0.19
	Protein	0.18	0.22	0.13	0.10
	Vitamin A	0.23	0.26	0.24	0.28
	Vitamin C	0.05	0.22	0.03	0.12
	Iron	0.06	0.28	-0.25	0.19
	Calcium	0.17	0.31	0.24	0.28
Non-breastfeeding	Energy	0.14	0.48	0.14	0.45
	Protein	0.18	0.44	0.16	0.37
	Vitamin A	0.09	0.38	0.00	0.29
	Vitamin C	0.17	0.38	0.20	0.39
	Iron	0.20	0.37	0.20	0.23
	Calcium	0.23	0.43	0.19	0.36
Children	Energy	0.13	0.14	0.23	0.10
	Protein	0.19	0.15	0.31	0.03
	Vitamin A	0.28	0.03	0.30	0.07
	Vitamin C	0.10	0.19	0.19	0.29
	Iron	0.01	0.15	0.05	0.20
	Calcium	0.27	0.04	0.23	0.04

Table 4-9 Validity Coefficients for Harvard and Block FFQ-2

		All Cases Included		Outliers Dropped	
		Harvard	Block	Harvard	Block
African-American	Energy	0.31	0.41	0.45	0.44
	Protein	0.20	0.43	0.33	0.46
	Vitamin A	0.17	0.17	0.29	0.07
	Vitamin C	0.11	0.36	0.14	0.37
	Iron	0.15	0.43	0.28	0.47
	Calcium	0.35	0.46	0.56	0.54
Hispanic	Energy	0.16	0.13	0.12	0.06
	Protein	0.15	0.12	0.14	0.09
	Vitamin A	0.33	0.07	0.30	0.03
	Vitamin C	0.34	0.25	0.31	0.32
	Iron	0.34	0.04	0.11	0.07
	Calcium	0.18	0.29	0.15	0.18
White	Energy	0.36	0.42	0.41	0.40
	Protein	0.32	0.47	0.36	0.46
	Vitamin A	0.27	0.61	0.31	0.52
	Vitamin C	0.43	0.35	0.49	0.24
	Iron	0.25	0.51	0.26	0.51
	Calcium	0.46	0.51	0.54	0.43
All Women	Energy	0.24	0.31	0.33	0.31
	Protein	0.22	0.33	0.29	0.34
	Vitamin A	0.23	0.23	0.26	0.17
	Vitamin C	0.33	0.36	0.33	0.35
	Iron	0.25	0.30	0.21	0.33
	Calcium	0.32	0.45	0.48	0.41
Pregnant	Energy	0.18	0.24	0.44	0.34
	Protein	0.22	0.31	0.39	0.42
	Vitamin A	0.16	0.25	0.24	0.35
	Vitamin C	0.33	0.17	0.33	0.27
	Iron	0.18	0.19	0.29	0.37
	Calcium	0.22	0.36	0.43	0.37
Breastfeeding	Energy	0.31	0.29	0.35	0.32
	Protein	0.20	0.21	0.31	0.26
	Vitamin A	0.26	0.25	0.24	0.16
	Vitamin C	0.28	0.40	0.37	0.37
	Iron	0.26	0.38	0.07	0.43
	Calcium	0.33	0.34	0.48	0.28
Non-breastfeeding	Energy	0.14	0.33	0.17	0.24
	Protein	0.16	0.40	0.11	0.32
	Vitamin A	0.19	0.16	0.19	-0.05
	Vitamin C	0.25	0.40	0.16	0.36
	Iron	0.23	0.27	0.19	0.14
	Calcium	0.34	0.48	0.35	0.45
Children	Energy	0.15	0.33	0.29	0.31
	Protein	0.22	0.27	0.35	0.15
	Vitamin A	0.29	0.08	0.21	0.09
	Vitamin C	0.18	0.22	0.20	0.33
	Iron	0.08	0.26	0.16	0.39
	Calcium	0.29	0.20	0.28	0.20

discussion, correlations lower than 0.4 are deemed to indicate a relationship too weak to be useful.

In addition, the correlations achieved by the Harvard and Block instruments were tested to determine whether they were statistically different from each other (Kleinbaum 1982). This is a stringent test; for All Women (core analyzed data with no FFQs dropped) correlations for the two FFQs would have to differ by more than 0.18, and for the subgroups they would have to differ by approximately 0.32 or more to be significantly different.

It is of interest to compare the two FFQs when identical edit criteria are used. The Harvard FFQ has a single outlier criterion of "greater than 4,500 kcal." When this energy criterion is applied to the Block FFQs in this study, only eight Block FFQs would exceed 4,500 kcal. Thus, a comparison of Harvard (outliers dropped) with Block (no outliers dropped) approximates a comparison using identical criteria. This is only an approximation because the eight Block cases > 4,500 kcal remained in the Block data.

Consequently, several sets of comparisons are possible:

- the two FFQs, with all core participants included (n = 650);
- the two FFQs, after dropping their respective "outliers" based on the separate edit criteria; and
- the two FFQs, using comparable energy edit criteria (i.e., Harvard FFQ outliers dropped *vs.* no Block FFQ outliers dropped).

Validity Correlation Results

Appropriateness of Using FFQ-1

For most of the analyses presented in this section, emphasis is placed on the results involving the first administration of the FFQ. This is appropriate for several reasons. The second FFQ took place after a month of repeated focus on that person's dietary intake, and after a prior administration of the same FFQ. Repeated administration involves a learning experience on the part of the respondent, a learning experience that unquestionably alters the respondent's ability to complete the questionnaire. This learning experience is not representative of the probable WIC situation. It is important for FNS to assess the

performance of the FFQs when they are administered by a naive respondent. For this purpose, the first FFQ is considered to be the more appropriate administration for validity testing.

Use of FFQ-2 for Validity

For purposes of abstract "validity," it is also appropriate to consider the correlations associated with the second FFQ administration, since it corresponds to the time period during which the reference data were collected. Consequently, the second as well as the first FFQ correlations are shown in this report. It is likely that to a considerable extent the dietary intake of the study population did not differ substantially from the prior month, since approximately two-thirds of the subjects had been on WIC in the month prior to their entry into the study.

Averaging of FFQ-1 and FFQ-2

Also performed were correlations for the nutrient estimates averaged over the first and second administrations. This approach, shown only in the Appendix, is a widely accepted method that, like averaging multiple days of diet records, reduces the error variability associated with a single administration, and yields a correlation estimate closer to the "true" abstract correlation of the instrument with the reference data.

"No Outliers Dropped"

Comparisons of data with all study subjects included (no outlier FFQs dropped) provides a realistic picture of the quality of the data which would be presented to a WIC nutritionist examining the responses to the completed questionnaire, food servings, etc. For both Harvard and Block, identification of truly suspect questionnaires occurs only after computerized FFQ analysis (although limited visual editing can identify some questionable responses). Thus, examination of "no outliers dropped" is essential for an evaluation of the real-world usability of the instruments.

Comparisons of data with questionable study subjects excluded ("outlier FFQs dropped") provides a picture of the data quality possible after computerized edits have identified probable erroneous questionnaires. This examination is useful in assessing the value of the instruments for the identifiable subset of "good" questionnaires, and their

value for other uses such as investigating changes over time or comparisons of aggregate data within or across WIC regions.

Supplements

Vitamin and mineral supplement use was also obtained in both the diet recall data and the Block FFQ (but not the Harvard FFQ). Correlations including supplements are not presented in this report because of FNS' emphasis on foods. Without inclusion of nutrients obtained from supplements, it is possible to evaluate the performance of the FFQs among persons who do not take supplements. However, two-thirds of the WIC population did take supplements, and supplement sources comprise a significant component of their nutrient intake. At some future time it may be valuable to investigate the performance of FFQs in assessing total nutrient intake.

Results for First FFQ Administration

In comparing results for the three ethnic groups (African American, Hispanic, White), moderately acceptable correlations are seen for the Block FFQ among African Americans and Whites. Neither FFQ performed well among Hispanics. The modest to poor correlations seen for All Women are a reflection of the fact that one-third of the sample was Hispanic women, who did poorly. Similarly, modest correlations by WIC category (pregnant, breastfeeding, non-breastfeeding) also reflect the inclusion of Hispanics in the sample. Results just among African Americans and Whites are discussed below.

Harvard *vs.* Block FFQs (No FFQ Outliers Dropped)

For the groups shown in Table 4-8, "All Cases Included," the Block FFQ achieved a higher correlation in 35 of the groups, and the Harvard FFQ achieved a higher correlation in 13 of the groups. In Block, 13 correlations were equal to or higher than $r = 0.40$; in Harvard, three correlations were equal to or higher than 0.40. The Block instrument performed better than Harvard for Whites and African Americans. Of the 12 such comparisons for Whites and African Americans, the Block FFQ achieved nine correlations equal to or greater than 0.40. Although Harvard performed better than Block among Hispanics, almost all the correlations

were poor. Only one of the six Harvard correlations in Hispanics equaled or exceeded 0.40. In terms of the statistical significance of the difference in the correlations achieved by the two instruments, only five comparisons achieve significance (non-breastfeeding Energy, African-American Energy, African-American Vitamin C, African-American Iron, White Vitamin A), and, in all cases, it is the Block instrument that is higher. The difference between Harvard and Block correlations for energy among All Women *approaches* significance ($p = 0.052$ when significance is $p < 0.05$) with Block correlating higher than Harvard, $r = 0.37$ (Block) *vs.* $r = 0.19$ (Harvard).

By WIC category (pregnant, breastfeeding, non-breastfeeding), 15 of the 18 correlations were higher by the Block FFQ than the Harvard FFQ. With few exceptions these correlations were modest. As noted above, to some extent the modest correlations by WIC category reflect the presence of Hispanics as one-third of each group. This is discussed further in the discussion of ethnic comparisons below.

For children's results, Block produced higher correlations than Harvard for three nutrients, and Harvard was higher than Block for three nutrients. All results for both instruments were extremely poor, the highest being 0.27 in FFQ-1 (Harvard calcium) and 0.33 in FFQ-2 (Block energy).

<u>Outliers or Questionable Responders Excluded (Outliers Dropped)</u>

The results are similar when the correlations are examined after the exclusion of outliers (see Table 4-8, 'Outliers Dropped'). Although most of the observed differences are minor in magnitude, 34 are higher in Block and 14 are higher in Harvard.

With few exceptions, the FFQ-1 correlations are poorer after the exclusion of outliers, for both Harvard and Block. This is different from what has been seen in other studies (Block 1990a, 1992). There are several possible explanations. First, the lack of improvement in correlations after FFQ errors are excluded suggests that errors may be occurring extensively in the reference data, not excludable by FFQ exclusion criteria. Further, the fact that correlations are worse after exclusion of FFQ errors suggests that some good correlations may be the result of similar errors in the FFQ and diet recall data. That is, the kinds of errors screened out by both sets of FFQ edit criteria tend to be errors of exaggeration, such as, caloric estimates too

high, or individual foods improbably high. Similarly, in the diet recall data, a tendency was observed for some study subjects to provide improbably high estimates, resulting in this case not from erroneous frequency but from erroneously large portion sizes. These errors, when left in, would tend to artificially increase the range and slope of the nutrient estimates. The exclusion of these two conjoint errors, erroneously high estimates on both test and reference methods, would tend to increase the apparent agreement between the two methods. Exclusion of those erroneously high values would tend to reduce the correlations, as was seen in these results.

Approximately Equal Exclusion Criteria, >4500 kcal (Harvard Outliers Dropped *vs.* Block All Cases Included)

Block with all cases included had higher correlations in 35 of the 48 comparisons, while Harvard with outliers dropped had higher correlations in 13 of the comparisons. Thirteen of the Block correlations were 0.40 or greater; two of the Harvard correlations were 0.40 or greater. Thus, it appears that overall, the Block instrument without any exclusions performed better than the Harvard instrument with approximately 13% of study subjects excluded due to high caloric intake alone.

Analyses by Ethnic Subgroup

Because the correlations among Hispanic women were the poorest of the three ethnic groups, analyses were carried out to investigate the role of ethnicity in the correlations seen in each of the WIC categories (pregnant, breastfeeding, non-breastfeeding, children; data not shown). It was thought that correlations might be higher in some of these groups if only African-American (AA) or White (W) study subjects were considered. This combined group is referred to as "AA-W" below.

Block. Of 18 category-nutrient correlations examined among women (6 nutrients x 3 WIC categories, for example, 'energy among pregnant women'), 14 were higher when only AA-W women were included than when all three ethnic groups were included.

Harvard. Nine of the 18 correlations were higher when Hispanics were excluded, and 9 were the same or lower. In particular, the Harvard correlations were higher for Hispanics than for African Americans or Whites in vitamin A and vitamin C.

Block vs. Harvard. When correlations just among AA-W are considered for the three WIC categories, Block results are higher than Harvard's in 14 of 18 group-nutrient correlations. When correlations just among Hispanic women are considered, Harvard results are higher than Block's in 14 of 18 comparisons. The higher correlations among Hispanics are the sources of the higher Harvard correlations among pregnant women for vitamin A and calcium in Table 4-8.

It would appear that among AA-W women, the Block instrument performs better than the Harvard FFQ. While Harvard achieved higher correlations among Hispanics than the Block FFQ, neither instrument can be considered adequate for Hispanic women.

Analyses by WIC Category

Women. When just African-American and White study subjects are included, the results by WIC category are more encouraging than they appear in Table 4-8. Among Block FFQs, eight of the 18 correlations exceed 0.40; among Harvard FFQs, 5 of 18 exceed 0.40. Block had higher correlations than Harvard for five of the six nutrients among pregnant women, and in all of the six nutrients among non-breastfeeding women, while Harvard and Block were each higher on three of the nutrients among breastfeeding women.

Children. Among children, the conclusions about the performance of the FFQs is not altered by the ethnic-specific analyses. Hispanics are not the source of the poor correlations; indeed, their results are superior to the AA-W mothers in three of the six Block nutrient comparisons and four of the six Harvard comparisons. The Harvard AA-W results are higher than those of Block in four of six comparisons, but none of these correlations exceeds a relatively low 0.31. Harvard Hispanic children have higher correlations than Block's in four of six nutrients, and two of these exceed 0.40.

Results for Second FFQ Administration

All Cases Included

For the second administration, results shown in Table 4-9 are similar to those for the first administration. Most of the Block correlations for Whites and African Americans are reasonably acceptable. Correlations among Hispanic women are poor by both instruments. The Harvard correlations for Hispanics tend to be higher than the ones for Block, but neither instrument produced any correlations of 0.40 or greater in this ethnic group. Four of the six correlations for children are higher by Block, but performance by both instruments is poor for Hispanic women.

FFQ Outliers Dropped

Exclusion of outliers did improve correlations in FFQ-2 for about three-fourths of the Harvard FFQ-2 correlations, and about half of the Block correlations. Interestingly, the exception to this was among Hispanics, whose results did not improve after exclusions. This suggests the possibility that among Hispanics, at least, an important source of the poor correlations was:

- errors in the reference data (the diet recalls); and/or
- FFQ errors that occurred throughout the FFQs in a way not amenable to exclusion based on either excessively high energy or unreasonably high frequencies of individual foods.

After exclusion of outliers, the two instruments had an approximately equal number of "superior" correlations, that is, higher than the other FFQ type, although in some cases by only minor amounts. Of these correlations 25 were higher for Harvard while 22 were higher for Block. Additionally, 9 Harvard correlations and 12 Block correlations were greater than r = 0.40. When Block *All Cases Included* was compared with Harvard *FFQ Outliers Dropped*, 11 of 18 ethnic comparisons and 11 of 18 WIC category comparisons were higher for Block, suggesting again that the Block instrument, without any exclusions, performed approximately as well as or slightly better than the Harvard FFQ with fully 13% of the Harvard cases excluded due to outlier energy values.

Use of Standard Medium Portion Size with the Block FFQ

Also examined was the correlation between diet records and the Block FFQ-1 when calculated using a Standard Medium portion size, rather than the customary "small-medium-large" approach. It was thought possible that it might perform nearly as well as the "small-medium-large" approach; if that were the case, it would be the preferable choice for WIC, in that it is less complicated (less to process) for the WIC client. With few exceptions, (data not shown) however, correlations using a Standard Medium were considerably lower than those shown in Table 4-8 for the Block FFQ. An exception was for non-breastfeeding women, where the Standard Medium correlations were slightly but consistently higher. Among Hispanics, the Harvard questionnaire continued to show higher correlations for five of the six nutrients. Thus, using the simpler format for the Block FFQ did not correct the poorer correlations in Hispanics. However, for the other 42 correlations in Table 4-8, 30 continued to be higher than the corresponding Harvard correlations using only Block's standard medium.

Average of Estimates from FFQ-1 and FFQ-2

Averaging two administrations of the FFQs reduces some of the intraindividual variability associated with respondent errors or changes in diet. Consequently, correlation of this estimate with the diet recalls gives a better picture of the "true" correlation between the instrument and the reference data. The results of this *averaging* analysis are shown in Appendix D, Table D-3. For both instruments the correlations were higher when the FFQs were averaged, and a number of correlations were moved above 0.50. This in turn suggests that further consideration of and work on these instruments is warranted for use in WIC settings.

Reasons for Some of the Poor Results

Often, very poor correlations, such as those seen in some of the results in Table 4-8, result from just one or a few study subjects. For example, we explored the poor correlation ($r = 0.12$) for vitamin C seen among pregnant women by the Harvard FFQ. Among the 27 Whites this correlation was $r = 0.18$. However, that low correlation was caused entirely by a single respondent who had a very low vitamin C intake by diet recalls (24 mg/day), but an

anomalously high vitamin C intake by FFQ (586 mg/day). She reported on the Harvard FFQ that she had oranges once per day, 4 to 5 glasses of orange juice per day, 4 to 5 glasses of Hi-C/Kool Aid per day, and several other fruits frequently. With this single respondent excluded, the correlation among the remaining 26 White pregnant women was 0.43. Similarly, the low correlation for vitamin C among Block White women was found to be due to six study subjects. Excluding these six subjects, the correlation for the rest of the 68 women in that group was 0.42.

This example highlights some of the shortcomings of the edit criteria used by each of the FFQ instruments. Apart from visual editing, the Harvard FFQ excludes study subjects only if their energy estimate exceeds 4,500 kcal. While indeed excluding numerous erroneous responses, this approach does not exclude persons with erroneously high estimates of nutrients not strongly associated with energy, such as vitamin C. The Block edit criteria excluded study subjects for, among other things, having more than one food with unreasonably high reported frequencies. This leaves in study subjects who do not fail on two, but who might have said, for example, that they eat sweet potato twice a day, a single unreasonable frequency that would put them far in the extreme on vitamin A intake.

The correlations for vitamin C for the Block FFQ are a great deal lower than has been seen in other validations of this instrument, and lower than the correlations obtained for other nutrients in this study. Thus, an explanation was sought for these results. It was discovered that the frequency categories used for important vitamin C sources were different in this instrument than in previous versions of the Block FFQ.

In previous versions of the Block FFQ, the two important beverage sources of vitamin C, *orange juice* and *beverages high in vitamin C, such as Hi-C or Kool Aid*, have frequency categories with a maximum of *two times per day*. In the version used in this study, however, these beverages were placed with a 'beverage group" of items, and consumption as often as *five to six times per day* was permitted. A possible result may have been that those respondents wanting to indicate a high frequency of intake used the maximum category of *five to six times per day* and thus exaggerated their real intake (as measured by the reference recalls). Unfortunately, assuming the previously used frequency categories with a maximum of *two times per day* for calculation purposes did

not alleviate this problem, presumably because some respondents had correctly estimated their frequency. Changing the meaning of the frequency categories improved the overestimates for some respondents, but misestimated the frequencies of respondents who had reported correctly. Thus, it is not possible to demonstrate notably improved correlations. However, it is likely that the vitamin C correlations will be comparable to other nutrient correlations seen in this study, and to previous results for vitamin C, if the current Block FFQ used for this study is <u>modified</u> to reflect the previously used frequency categories. It is advisable to revise the frequency categories for juices as well as other beverages, to improve correlations and reduce overestimates.

Comparison of Harvard Results with Previously Published Suitor Data

Suitor et al. (1989) published a validation study using an FFQ similar to the Harvard FFQ used in this study. The most comparable data to those of Suitor et al. are those from the first administration of the FFQs, before any exclusions of outliers, for pregnant women. For the six nutrients considered in this study, the present correlations for FFQ-1 *All Cases Included* are higher than Suitor's for three nutrients, similar in one, and lower in two nutrients. This similarity of results is particularly reassuring when one considers in detail the nature of the two samples. Suitor's initial sample was 59% White, 21% African American and 20% Hispanic; of these, 6-9 persons were dropped before the calculation of Suitor's FFQ-1 correlations; while their ethnicity is not stated, our data would suggest that they are more likely to have been Hispanic or African American, leaving a still more Caucasian study group. In comparison, the sample in the present study was much more heavily weighted with Hispanics and African Americans, each comprising approximately one-third of the study sample. Further, the Suitor data include only those Hispanics who were able to complete the English version of the FFQ, whereas in the present study approximately 80% of the Hispanic study subjects used the Spanish-language FFQs, and most would have been unable to complete an FFQ in English. When this study's African-American/White data are compared with the correlations seen by Suitor, they exceed those obtained by Suitor for all nutrients except vitamin C.

Comparisons of Suitor's first questionnaire after exclusion of outliers with the present Harvard results after exclusion of outliers have several interesting aspects. When all three

ethnic groups are included, the present correlations are considerably lower than Suitor's. However, correlations of data among Whites are higher for all nutrients, and for protein and vitamin A are substantially higher than Suitor's. In a further exploratory step, the data were log transformed, as Suitor had done, rather than using the most normalizing transformation decision (which may be log, square-root or no transformation at all depending on the specific distribution). Interestingly, log-transformed correlations for Whites were substantially higher than the original transformation for four of the six nutrients. Thus, considering a similar ethnic distribution and applying the same transformations, the present results for the Harvard FFQ-1 after dropping FFQ outliers were similar to Suitors: lower for calcium and vitamin C, considerably higher for protein and vitamin A, and similar for energy and iron.

Comparisons of the second administration of the FFQ in the present study (FFQ-2) with Suitor's second administration (PFFQ-2) are not appropriate, because those who remained in the Suitor study through to the second administration were a select group. As noted by Suitor et al. (Suitor 1989), "those returning PFFQ-2 were unrepresentative of the original sample, being mainly White adults, high school graduates, and above the federal poverty level."

Possible Explanations for the Poor Performance Among Hispanic Women

There are several possible explanations:

- The FFQs do not have sufficient or correct ethnic foods on the food list;
- A lack of familiarity with "data collection" forms, or culturally different conceptualizations about reporting food intake, may have made it more difficult for the Hispanic women in this study to use the FFQs as intended by the researchers;
- The same above problems of education and abstract thinking make it difficult to report food intake correctly on the diet recalls;
- The diet recalls may not accurately reflect their dietary intake because of lack of or inaccurate nutrient content information; and/or
- The diet recalls may not accurately reflect their dietary intake because of the error-proneness of the process of recording nutrient and portion size information from mixed dishes.

Each of these is discussed below.

Not Enough or Not Correct Ethnic Foods on the Food List. Further work in this area is warranted; however, it may not be the major source of error. Extensive preliminary examination of nutrient sources in Hispanic-HANES (Block 1994) revealed a relatively minor contribution of most ethnic foods, and the few important ones were included on the Block FFQ. Furthermore, several focus groups conducted among Hispanic women did not suggest important additional foods. In addition, Hispanic nutritionists in each of the geographic sites examined the draft FFQ prior to the beginning of the study, in an effort to improve both the food list and the translations used. However, it should be noted that mixed dishes comprise an important part of Hispanic diets, and therefore it may be that more *specifically Hispanic* mixed dishes should be included.

Lack of Familiarity with Data Collection Forms. This could be an important factor although there are no supporting data from this study for this specific hypothesis. It was measured that Hispanic study subjects took the longest time to complete the FFQs, committed the most errors and required the most assistance and explanation (see Section 4.2). Perhaps related, it was observed that the educational level among Hispanic study subjects was considerably lower than among Whites or African Americans. For example, 5% of Hispanic women had only 0, 1 or 2 years of education. Fully 29% of the Hispanic women in this study had six years of education or less. In comparison, only two African-American women and no White women had as little as eight years of education. In this study population the non-Hispanic women were mostly high school educated with only 18% of White and 19% of African-American women having less than a full 12 years of school. However, the poorer results for Hispanic women cannot be attributed to education alone. When correlations were examined separately by educational level, they were not any higher among Hispanic women with 9-12 years of education than they were among those with only 0-8 years of education. Cultural differences in relating to data collection forms, perhaps associated with the educational experience, is a possible hypothesis to be explored.

Difficulties In Providing Accurate Diet Recall Data. Considerable data suggest that the information provided by the Hispanic women in this study was of relatively "poorer" quality, making lower correlations inevitable. Sources of error here include both memory errors in reporting foods consumed, and probably more importantly, the quantification of

portion size as part of the reporting. As described in Section 3, the quantification of portion size using the abstract two-dimensional shapes appeared to be difficult, generally, and a potentially serious source of error. Cultural differences related to recalling diet and reporting food intake may be contributing factors.

Possibly Inaccurate Nutrient Content Information for Hispanic Foods. Because many foods are not standard parts of the U.S. diet, their nutrient content data may be less reliable than that of more mainstream foods. Perhaps also important may be the micronutrient content assumptions by the NDS database for some fruit drinks. Among Hispanics, ethnic or homemade fruit drinks or punches are an important dietary factor. Incorrect assumptions about vitamin C content, for example, could lead to serious errors for that nutrient.

Diet Recall Errors Due to Difficulties in Recording Mixed Dishes. To a greater extent than among Whites or African Americans, prepared mixed dishes comprise a substantial part of the diet among Hispanics. In a diet recall, mixed dishes are obtained in two ways: either a single NDS recipe for a mixed dish is assigned to all preparers and ethnic subgroups; or, the recipe must be recorded, with each food recorded separately by type and portion size. This process contains the possibility of error in remembering accurately the amounts of each food that went into the recipe cooked for the family; difficulties in estimating the amount of the final recipe consumed by the respondent; and the possibility that the interviewer recording the information may incorrectly assign the proportion of each food in the recipe that was consumed by the respondent.

Suggestions for further research to improve dietary assessment among Hispanics are included in Section 5.0.

Possible Explanations for the Poor Performance Among Mothers Responding for Their Children's Diets

Again, there are several possibilities:

- Food lists perhaps did not include enough infant or young child foods; or assigned portion sizes which were not appropriate;
- The process of thinking about their children's diets on a food frequency questionnaire is too difficult;

- Very small children's diets have so little variety that the range of intake is too small to permit good correlations;
- The diet recalls are poor reflections of the children's diets because the mothers may not know what the children eat in day care or friends/relatives' care;
- The quantification of portion size by the mothers in the diet recalls is difficult and error-prone; and/or
- The diet recalls are poor reflections of the children's diets because nutrient content information is not appropriate for the foods/juices commonly consumed by young children.

Each of these is discussed below.

Food Lists or Portion Sizes Not Appropriate. It appears unlikely that food lists or inappropriate portion sizes are a major source of the errors. The Harvard instrument based the food list on an extensive examination of CSFII data for children, and the portion sizes on USDA data on children's portion sizes. Similarly, the Block instrument based the additions to the food list on NHANES II and Hispanic-HANES data on nutrient sources, and portion sizes among low-income children ages 1-4.

Difficulties of Mothers in Reporting About Their Child's Diets. In pretesting of the Block FFQ among WIC mothers, it was observed that sometimes the mothers forgot that they were supposed to be reporting on their child's diet, and slipped into reporting on their own diet. (To minimize this problem, the form was changed to request that the mother write the child's name at the top of each page.) While this particular problem may have provided some source of error, it is unlikely to have been a major source. Another possibility is that the mothers optimized the reporting of their children's food intake, perhaps out of embarrassment or guilt at revealing poor dietary practices. However, a more likely explanation is simply that it is a difficult and abstract task to report on how frequently someone else eats a food.

Limited Variety in Small Children's Diets. Small children's diets are very restricted. Often, the resulting questionnaires report consumption of cooked or dry cereal, baby food fruit, milk, and a few snack foods. While the resulting diet may actually be nutritionally adequate, the intake of protein and micronutrients may vary over a very small range in the sample of small

children. Under circumstances of a very narrow range, it is simply mathematically difficult to achieve high correlation coefficients, in part because it requires a much greater degree of precision on the part of the FFQ. Additionally, when very few foods are reported, the importance of accurately reporting portion size of those foods in the diet recalls increases. However, while this lack of variability in small children's diets may be a factor, better correlations among the older children could not be demonstrated in these analyses. It was found that the correlations among 3-4-year olds were not better than the correlations among 1-2-year olds (data not shown).

Diet Recalls May Be Inaccurate Because Mothers Don't Know the Entire Diet of Child. By study design, mothers were to be enrolled only if they in fact had supervision of their children during the day, that is, the children were not to be in day care, etc. Some mothers may have misunderstood the question, and thus it is possible that some children were included in the study who were not in formal day care facilities, but who were taken care of by relatives. Finally, inevitably all mothers have occasion to leave their children with relatives or friends from time to time to do errands, etc., and thus they would not know exactly what their children had eaten during those periods. While this is an important element of study design for future studies, it is unlikely to be a major source of error in this study, in part because it was largely avoided by design, and in part because the mother's ignorance of the child's complete diet would have been true for both the diet recalls and the FFQs.

Errors in Diet Recalls Due to Portion Size Quantification. As indicated, the visual two-dimensional portion size models were found to be difficult to relate to actual utensils, and a probable source of error. Glass sizes were difficult to visualize and translate into actual three-dimensional glasses. Exaggeration or minimization of the glass sizes of milk consumed by a child could introduce major errors in estimation of energy, protein, calcium and vitamin A.

Diet Recall Database May Not Be Appropriate for Foods Consumed by Small Children. The nutrient content of jars of baby food is probably accurately contained on the database. However, young children drink a lot of juices, and it may be possible that the "sippies," juice boxes and similar drinks enjoyed by children, do not have accurate corresponding codes on the database. The nutrient content of Kool Aid illustrates the type of error that can lead to misestimation of nutrient intake of children. According to the Kraft

General Foods corporation, there is no calcium in Kool Aid; the codes used for Kool Aid in the NDS database, however, provide a considerable amount of calcium.

Comparison of Diet Recalls *vs.* Food Frequency Questionnaires

The correlations shown in this section for the Block FFQ for African American and White (AA-W) women, Table 4-8, are within the range of 0.4 to 0.6 for most nutrients. After adjustment for measurement error in the diet recalls, correlations for those two groups are seen to be higher (Appendix D, Table D-1), reaching or exceeding 0.5 for 7 of the 12 comparisons. Values such as these indicate an ability to rank individuals along the distribution of intake from low to high that is quite comparable with results from other studies.

It was of interest to compare these correlations with those that might be seen from use of a single research-quality 24-hour diet recall as the assessment instrument. To explore this, the sample was restricted to African-American and White women, the subset for whom the FFQ seems to perform adequately and who had all completed three diet recalls. For this comparison, the first two 24-hour diet recalls were averaged, and the performance of the third diet recall was assessed by correlating it with the average of the other two. These correlations were compared with the correlations seen for the Block FFQ against the two averaged diet recalls (see Table 4-10).

It can be seen that the correlations achieved by the FFQ are somewhat lower than those achieved by a single 24-hour diet recall for macronutrients, but are similar for micronutrients. That is, for macronutrients, a diet recall agrees with estimates from other diet recalls better than does an FFQ.

Note that the correlations achieved by the 24-hour diet recall are probably overestimates, because of the problem of "correlation errors." That is, a person may exaggerate her serving size of cereal, for example, on all three diet recalls. This will produce good apparent agreement, but all three estimates would in fact be incorrect. It is because of this problem of correlated errors that a food frequency questionnaire is never "validated" by comparing it against another FFQ. The "validity" estimate would be incorrectly high. For the same reason, it is likely that the correlations seen for one 24-hour diet recall in Table 4-10 are incorrectly high. Thus, it is difficult to distinguish the agreement due to corresponding errors

from the agreement due to accurate nutrient estimates, in the first column of Table 4-10. This table suggests, however, that for macronutrients, a research-quality 24-hour diet recall produces better agreement with other diet recalls than does a self-administered FFQ in this low-income population. For micronutrients, an FFQ is approximately equal to a research quality 24-hour diet recall.

Table 4-10

Spearman* Correlations, African-American and White Women

n = 127

Nutrient	Recall 3 vs. Average of Recalls 1 & 2	Block FFQ-1 vs. Average of Recalls 1 & 2
Energy	0.57	0.43
Protein	0.61	0.45
Vitamin A	0.33	0.34
Vitamin C	0.40	0.40
Iron	0.44	0.37
Calcium	0.61	0.54

* Spearman correlations remove the requirement for data transformation.

It should be remembered that this was a research-quality 24-hour diet recall, taking approximately 20 minutes to complete and involving probing and ascertaining all foods consumed and their portion sizes and preparation methods. Less extensive methods of obtaining diet recall data would result in lower correlations than those shown here for Diet Recall 3. For situations in which a research-quality 24-hour diet recall is not practical, the analyses in Table 4-8 suggest that for women of these two ethnic groups (AA-W), a food frequency questionnaire (here the Block FFQ) may be useful for assessing nutrient intake and eligibility in the WIC clinic situation.

Comparability of Nutrient Databases

The nutrient databases used in each FFQ's computer software and in the reference data in this study were not identical. The two Block and Harvard FFQs used databases developed in somewhat different ways. The Block FFQ database was initially based on the *NHANES II nutrient database*, somewhat updated using Revised Handbook No. 8. The Harvard WICENTER database was developed using the *USDA Nutrient Data Base for Standard Reference* (release 5, Microcomputer version) also updated using Revised Handbook No. 8. Each of these FFQs was in turn compared with reference data calculated using the *University of Minnesota Nutrition Data System's (NDS) unique nutrient database*.

While these three databases may seem to be different, it should be remembered that all nutrient databases (including NHANES II; USDA's Standard Reference; and, the University of Minnesota database) ultimately obtain their nutrient composition data from the USDA. NHANES II included considerable nutrient data from food manufacturers, as does the Minnesota database. Use of the Minnesota nutrient composition database to develop an FFQ nutrient database might have increased the resulting correlations somewhat. However, it is unlikely that it would have made a substantial improvement. Previous validations of the Block FFQ have all been conducted under the similar situation where the FFQ and reference databases were not identical. The good correlations obtained in those validation studies suggested that the FFQ is robust to such database differences.

In an attempt to determine the extent to which database differences might have influenced the results of this study, the Block FFQ database was modified to make it more similar to the Minnesota nutrient database, and the correlations with the NDS-based reference data recalculated. Vitamin C was selected, because the correlations for that nutrient were uncharacteristically low. The Minnesota database was first examined for the top food item contributors of vitamin C in the Block FFQ: orange juice, oranges, Kool Aid, broccoli and dry cereal. The values for dry cereal and for oranges were virtually identical in the Block and NDS databases. Broccoli values differed substantially depending on whether the broccoli was raw or cooked, but changing the FFQ database

had no effect on the correlations. The values for Kool Aid and for orange juice did differ somewhat in the Block and NDS databases: for orange juice, 48 mg. vs. 38 mg. vitamin C/100 g; and for Kool Aid, 15.6 mg. vs. 2.4 mg. vitamin C/100 g (for at least one of the NDS Kool Aid codes.)

The FFQ database was changed for those two food items accordingly, and the nutrient estimates and correlations recalculated. While the correlations were in fact improved, the improvements were <u>not</u> substantial. Among African-American women, the correlation improved from r = 0.35 to r = 0.37; among White women, the correlation improved from r = 0.19 to r = 0.24. Thus, it appears likely that differences among the databases is not an important factor in the results observed in this study.

Conclusions Based on FFQ Validity Correlations

Improvements are needed, and are possible, for both FFQs. Even in its present state, however, the Block FFQ produces correlations with reference data for Whites and African-American WIC-eligible women which are not substantially poorer than correlations obtained by that and other instruments in more well-educated populations. (The exception, vitamin C, is poorer in this study than in other validations of the Block FFQ because of a formatting error.) Neither FFQ performs adequately for Hispanic women, and neither FFQ performs adequately for children. Some possible reasons for that are discussed above. Some of the reasons suggested pertain as much to the adequacy of the reference data as to the adequacy of the FFQs. Thus, the potential usability of FFQs for those populations should not be discounted, but further investigation is clearly needed.

4.4 CATEGORIZATION

Analytic Approach

The ability of FFQs to categorize persons as either low or high on the distribution of intake is a useful criterion of validity. For this analysis, the distribution of diet recall data for each nutrient was divided into quartiles. Likewise, the distribution of FFQ nutrient estimates was also divided into quartiles. This identifies each study subject in a specific quartile or category for each estimating method (diet recall and FFQ). These category (quartile) identities were then cross-tabulated to array the agreement between the two methods of categorization. A chi-square statistic is calculated to test the distribution in the array so that a highly significant chi-square value is an indication of a significant agreement. The largest chi-square value would be produced when all cases are perfectly distributed along the diagonal and there is no misclassification.

Because the correlation analyses presented in the previous section suggested that neither FFQ type performed adequately for Hispanics and for all children, the data in this categorization analysis have been restricted to African-American and White women only.

Results

Tables 4-11 through 4-16 show the cross-tabulations and statistical significance of the agreement between FFQ and diet recall categorization within quartiles for energy, protein, vitamin A, vitamin C, iron and calcium for the Harvard and Block data. The Block FFQ showed statistically significant agreement for all six nutrients. For the Harvard FFQ, statistically significant agreement was seen for protein and calcium but not for energy, vitamin A, vitamin C, nor iron.

Table 4-11

Agreement Between FFQ-1 and Average Diet Recall for Quartile Categories of ENERGY Intake Among White and African-American Women

HARVARD

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles) First	Second	Third	Fourth	Total
First	**17**	11	10	3	41
Second	9	**11**	11	10	41
Third	8	10	**10**	14	42
Fourth	7	9	11	**14**	41
	41	41	42	41	165

Chi-Square Significance: $p = 0.11$

BLOCK

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles) First	Second	Third	Fourth	Total
First	**14**	16	7	0	37
Second	13	**8**	13	4	38
Third	8	6	**11**	13	38
Fourth	2	8	7	**20**	37
	37	38	38	37	150

Chi-Square Significance: $p < 0.01$

Table 4-12

Agreement Between FFQ-1 and Average Diet Recall for Quartile Categories of PROTEIN Intake Among White and African-American Women

HARVARD

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles): First	Second	Third	Fourth	Total
First	**18**	9	10	4	41
Second	10	**16**	7	8	41
Third	6	7	**11**	18	42
Fourth	7	9	14	**11**	41
	41	41	42	41	165

Chi-Square Significance: $p < 0.01$

BLOCK

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles): First	Second	Third	Fourth	Total
First	**16**	13	5	3	37
Second	9	**13**	13	3	38
Third	7	10	**8**	13	38
Fourth	5	2	12	**18**	37
	37	38	38	37	150

Chi-Square Significance: $p < 0.01$

Table 4-13

Agreement Between FFQ-1 and Average Diet Recall for Quartile Categories of VITAMIN A Intake Among White and African-American Women

HARVARD

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles) First	Second	Third	Fourth	Total
First	**14**	13	7	7	41
Second	6	**9**	12	14	41
Third	10	9	**13**	10	42
Fourth	11	10	10	**10**	41
	41	41	42	41	165

Chi-Square Significance: $p = 0.47$

BLOCK

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles) First	Second	Third	Fourth	Total
First	**20**	8	7	2	37
Second	10	**9**	10	9	38
Third	4	11	**13**	10	38
Fourth	3	10	8	**16**	37
	37	38	38	37	150

Chi-Square Significance: $p < 0.01$

Table 4-14

Agreement Between FFQ-1 and Average Diet Recall for Quartile Categories of VITAMIN C Intake Among White and African-American Women

HARVARD

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles): First	Second	Third	Fourth	Total
First	**18**	5	8	9	40
Second	9	**11**	10	12	42
Third	7	10	**14**	11	42
Fourth	7	15	10	**9**	41
	41	41	42	41	165

Chi-Square Significance: $p = 0.07$

BLOCK

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles): First	Second	Third	Fourth	Total
First	**16**	11	5	5	37
Second	8	**13**	12	5	38
Third	6	6	**10**	16	38
Fourth	7	8	11	**11**	37
	37	38	38	37	150

Chi-Square Significance: $p < 0.01$

Table 4-15

Agreement Between FFQ-1 and Average Diet Recall for Quartile Categories of IRON Intake Among White and African-American Women

HARVARD

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles) First	Second	Third	Fourth	Total
First	**17**	11	6	7	41
Second	8	**9**	14	10	41
Third	6	9	**12**	15	42
Fourth	10	12	10	**9**	41
	41	41	42	41	165

Chi-Square Significance: p = 0.12

BLOCK

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles) First	Second	Third	Fourth	Total
First	**15**	11	7	4	37
Second	12	**11**	10	5	38
Third	3	13	**14**	8	38
Fourth	7	3	7	**20**	37
	37	38	38	37	150

Chi-Square Significance: p < 0.01

Table 4-16

Agreement Between FFQ-1 and Average Diet Recall for Quartile Categories of <u>CALCIUM</u> Intake Among White and African-American Women

HARVARD

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles): First	Second	Third	Fourth	Total
First	**18**	14	5	4	41
Second	11	**10**	14	6	41
Third	7	7	**13**	15	42
Fourth	5	10	10	**16**	41
	41	41	42	41	165

Chi-Square Significance: $p < 0.01$

BLOCK

FFQ-1 Categories (Quartiles)	Diet Recall Categories (Quartiles): First	Second	Third	Fourth	Total
First	**20**	10	7	0	37
Second	6	**17**	9	6	38
Third	7	7	**7**	17	38
Fourth	4	4	15	**14**	37
	37	38	38	37	150

Chi-Square Significance: $p < 0.01$

4.5 FFQ NUTRIENT ESTIMATES

Analytic Approaches

For the analysis of nutrient estimates, emphasis has been placed on the first administration of the FFQs, with all study subjects included. The first administration is most relevant to the real WIC situation, and the inclusion of all study subjects mimics the data as they would be presented to a WIC nutritionist in the absence of computerized analyses and edits. Each questionnaire's group mean was compared with the group mean from the 24-hour diet recalls, and a t-test performed. Results are shown in Appendix D. Tables D-4 through D-9 are calculated with no FFQs dropped due to FFQ outlier values, while Tables D-10 through D-15 represent the same set of analyses with FFQs dropped due to outlier values. Also shown separately in Appendix D are the results of nutrient estimates for FFQ-2 (the second FFQ administration) both including and excluding FFQ-2 outlier cases (Tables D-16 through D-27).

Nutrient Estimate Results

Note: *All tables referred to in this section are located in* ***Appendix D****. The tables in Appendix D compare the diet recall average estimates to the computer calculated FFQ estimates for the Harvard and the Block FFQs. Energy plus the estimates for the five nutrients of interest are presented. Medians, less influenced by extremely high values, are also presented.* *__Statistical significance__* *in comparing these estimated mean values is defined as a p-value of less than 0.05. All p-values presented in these tables have been rounded to two decimal places.*

<u>No FFQ Outliers Dropped</u>

<u>Energy (Table D-4)</u>. FFQ estimates for energy intake are consistently lower for the Block FFQ than the Harvard FFQ. Except for White women, the Harvard FFQ significantly overestimates mean energy intake. The Harvard mean FFQ energy intake of 2,685 kcal for All Women is significantly higher than the diet recall estimate of 1,994 kcal

while there is no difference in the Block mean estimate. For Children, energy was significantly overestimated by Harvard (2,043 FFQ kcal *vs.* 1,259 diet recall kcal), but was not overestimated by Block.

Protein (Table D-5). For protein, both FFQ median estimates for All Women are similar to the diet recall medians; the mean intake of protein, however, is overestimated by both types of FFQs, indicating the presence of outliers elevating the mean values. Protein was significantly overestimated for Children by both Harvard and Block.

Vitamin A (Table D-6). Both FFQs significantly overestimated vitamin A in all categories, ethnic groups. The overestimate was generally greater for the Harvard FFQ. Vitamin A was significantly overestimated for Children by both Harvard and Block with the Harvard overestimates being greater.

Vitamin C (Table D-7). Both instruments overestimated mean vitamin C intake in all categories, however only the Harvard FFQ overestimates were statistically significant. For Children, vitamin C was significantly overestimated by Harvard but not by Block.

Iron (Table D-8). For All Women, both FFQs produced identical median estimates of iron (10.8 mg) which, in both cases, were lower than the diet recall medians. The observed presence of some very high iron estimates among All Women in the Harvard data elevated the mean considerably higher than the median, producing a mean iron intake estimate not significantly different from the diet recall mean. The estimate of the Block FFQ mean iron intake of 11.6 mg for All Women is significantly below the diet recall estimate of 14.3 mg. For Children, iron was significantly underestimated by Block but was accurate for Harvard.

Calcium (Table D-9). Both FFQs significantly overestimated calcium in all ethnic groups and all categories. Calcium was significantly overestimated for Children by both Harvard and Block.

Summary of Women by WIC Category. Energy was significantly overestimated in the women in all three WIC categories by Harvard but not by Block. Both FFQ types overestimated vitamin A and calcium in all categories. Vitamin C was accurately estimated by Block and significantly overestimated by Harvard in all categories. Results for protein and iron varied in different categories, but not consistently for either Harvard or Block FFQs. Data for these pregnant, breastfeeding and non-breastfeeding categories, as well as the results for each of the ethnic groups, can be found in Tables D-4 through D-9 in Appendix D.

FFQ Outliers Dropped

The analyses described above were repeated for both FFQ types excluding those FFQs which were identified as unreliable based on each FFQ's respective editing criteria. The results of these analyses are shown in Tables D-10 through D-15 in Appendix D.

The exclusion of outlier FFQs, substantial for some groups, reduced Harvard's macronutrient overestimations and introduced a significant underestimate for the protein intake of Harvard White women. Dropping outlier FFQs did not relieve the overestimates of calcium and vitamin A for either instrument with the one exception of calcium intake among Harvard White women becoming an accurate estimate. The dropping of outliers made the Harvard instrument underestimate iron intake (where it did not before) while the Block instrument continued to underestimate iron intake.

Comparison of Harvard "Outlier FFQs Dropped" with Block "No FFQs Dropped" (Data not shown)

This is an attempt to compare the two instruments using identical exclusion criteria, namely kcal > 4,500, since only eight Block FFQs exceeded that energy level. Examining the number of t-tests that produced a significant difference ($p < 0.05$) between the FFQ estimate and the diet recall estimate, Harvard and Block have an equal number of such significant misestimates for All Women, African-American women and breastfeeding women. Harvard has one more significant misestimate than Block for White women and pregnant women, and Harvard has two more significant misestimates than Block for

Hispanic women, non-breastfeeding women, and children. On this basis, the Block FFQ with no study subjects excluded produced better point estimates of group mean intake than the Harvard FFQ, even after the exclusion of Harvard outliers.

<u>Second Questionnaire, FFQ-2 (Tables D-16 to D-27 in Appendix D)</u>

The FFQ-2 results benefit from the participant's learning experience involving both the prior administration of the same FFQ, and the three intervening telephone interviews about dietary intake. The FFQ-2 data show, as many other researchers have seen, that a second administration produces <u>lower</u> estimates of mean nutrient intake, and this was true both for Harvard and for Block. .For All Women, the Harvard mean energy dropped from 2,685 kcal in FFQ-1 to 2,255 in FFQ-2, while the Block mean energy dropped from 2,034 in FFQ-1 to 1,730 kcal in FFQ-2. This created some new significant underestimates (Examples: Block energy intake among All Women, Table D-16; Harvard iron intake among All Women, Table D-20). It also reduced some previously significant overestimates to non-significance (for example: Harvard and Block protein intake among All Women, Table D-17). Given the FFQ-2 estimates, general conclusions about the instruments examined in this study are unaltered.

<u>Block Questionnaire Using Standard Medium</u>

Block questionnaires ask the respondent to report whether her usual portion size was "small, medium or large" (S-M-L), and in the WIC version this was phrased as "compared to other women your age." Use of such a portion size question has been shown to result in superior correlations with reference data than use of a standard medium portion size assumption. However, since the omission of the portion size section would simplify future questionnaires for this population, this approach was also investigated.

Because poorer correlations were noted for "medium only" in Section 4.3, detailed tables of <u>means</u> are not shown here but were examined. In All Women, children and each ethnic group, use of "medium only" produced overestimates, or more severe overestimates, of energy, protein, vitamin A, vitamin C and calcium. This approach often resulted in statistically significant differences from the reference data in cases where the S-

M-L approach had not. Only for iron, which had been consistently underestimated with the S-M-L approach, did the higher estimates from "medium only" produce estimates closer to the reference data, although still statistically significantly lower than the reference data.

This observation of overestimates produced by "medium only" is consistent with earlier data indicating that standard medium portion sizes fail to capture gender and age differences. For example, standard medium portion sizes dramatically underestimate the nutrient intake of young and middle-aged men, and substantially overestimate the nutrient intake of older women. Previous data had suggested that they might be reasonably appropriate for young to middle-aged women, but the present data indicate that this is apparently not the case for WIC-eligible women. These results indicate that use of a "medium only" approach produces worse estimates than "small-medium-large," and is not to be recommended.

Vitamin Supplements (Block FFQ only). Vitamin supplement use was also obtained in both the diet recall data and the Block FFQ (but not the Harvard FFQ). Due to FNS' interest in nutrients from foods only, the values are not presented here. The results provide insight, however, into the use of vitamin/mineral supplements. On the FFQ, only about one-third of women reported consuming no vitamin supplements. (Note that two-thirds of the women were either pregnant or breastfeeding.) Supplements were primarily consumed in the form of multiple vitamins or prenatal vitamins, principally in the amounts found in the range of the Recommended Dietary Allowances (RDA). In the case of iron, the amounts consumed in a few cases appeared to warrant some concern. About half of the women reported consuming a total of 60 mg of iron per day, apparently the amount in a commonly consumed prenatal vitamin. However, approximately 5% of the women reported consuming 120 mg of iron per day, an amount much higher than the RDA for pregnant women. Occasional large amounts were also seen in the diet recalls.

Nutrient Estimation Conclusion

Both instruments consistently and significantly overestimated vitamin A and calcium. While the diet recall mean vitamin A intake is approximately 900 RE for All

Women, Block estimates about 1,500 RE and Harvard estimates about 2,500 RE. These overestimates are amenable to improvement. The Block calcium overestimate might be improved for the WIC population by handling the low-fat milk issue differently and not having two separate milk lines; Harvard might be improved by dropping some of the less important dairy items. The Harvard overestimate of vitamin A could be reduced by dropping some of the vegetable and fruit items, while the Block instrument might consider dropping liver. With the existing data, it is possible to explore, in the Block data set, the importance of specific foods to the group's nutrient intake, and whether dropping certain foods would improve point estimates without weakening the correlations. Such explorations could also be done in the Harvard data, using the Block software.

Overall, it would appear that the Block estimates tend to be closer to the diet recall group means and medians than are the Harvard estimates. It should be noted that production of accurate point estimates of group means was probably not a primary consideration in the development of either instrument. This has not been stated clearly for the Harvard instrument, but it has for the Block instrument. Previous work by Block with earlier instruments suggested that an instrument of only 60 items will tend to underestimate macronutrients (Block 1990b). That did not prove to be the case for the Block instrument in this WIC population, at least in FFQ-1, possibly because the diet in this population is less varied and therefore a shorter list, properly chosen, captures their total diet adequately. That the instruments consistently overestimate vitamin A and calcium is largely a function of the number of appropriate foods on the list, and is amenable to improvement. But a questionnaire can, in principle, still rank people correctly despite serious misestimates. Thus, conclusions about the value of one questionnaire over another should not rest on their relative accuracy in estimating group mean nutrient intakes.

National Nutrient Estimates for WIC Participants

In response to a requested analysis by the Office of Management and Budget (OMB) related to this study, national estimates of nutrient intake were calculated. That is, using the recall data provided by the African-American, Hispanic and White participants in

this study, separately for women and children, the nutrient estimates were weighted to USDA's 1992 WIC participant data for the nation. The methodology used and the resulting estimates for women and children are shown in Appendix E-6.

4.6 MANUAL SCORING

Analytic Approach

The performance of a manual scoring system is of great importance in judging the appropriateness of food frequency questionnaires for the WIC system. Because of financial and logistic constraints, it is likely that few WIC agencies would be able to computer-score these instruments in order to use them for eligibility decisions. Although this could change in the future if validity and usability were demonstrated and resources were made available, at the present time diet-related eligibility decisions will have to be made on the basis of the manual scores.

The Harvard and Block scores differ considerably in their methods and criteria for their development. Harvard scores were developed by Gardner/Suitor during the course of an earlier cooperative agreement with FNS, and are based on numbers of servings from five food groups; they produce a "pass/fail" result for each food group. Block scores were developed by selecting a subset of foods on the questionnaire, 'indicator foods' that represented the top contributors of the nutrients in question; they produce scores that are continuous variables for each nutrient.

In the Harvard manual score, laminated templates overlay each page, and reported servings of each food in a group are counted based on the column headings (1/day, 5-6/day, 6+/day, etc.). In the Block manual score, each of the 'indicator' foods is scored with a numeric value 0-4, and the foods then summed for each nutrient. Both methods are rapid, requiring only a median of three minutes to score.

In the analyses below, several different possible eligibility criteria are considered, and the performance of each scoring system evaluated in relation to these different criteria.

Results

Criterion I - "Below 100% of the RDA on any one of the five nutrients"

One possible eligibility criterion might be to certify as eligible if any one of the five nutrients was below the RDA. If that were the criterion, however, 95% of All Women are "eligible" by the diet recall data. In this situation, a rational WIC decision would simply be to declare all 100% to be eligible. Given the imperfect nature of dietary data, including recall data, use of any instrument to attempt to discriminate between the 5% and the 95% is inappropriate and perhaps even litigable. Furthermore, while certifying all applicants as eligible may be ethically defensible, it does not satisfy the fiscal need of WIC agencies for flexibility.

With 95% of women 'eligible' by the recall data, statistically valid comparison of the two FFQs becomes impossible. When there are only 5% who don't fail on this criterion, the numbers and the cell sizes become too small to evaluate appropriately. For example, in each FFQ type only 11 or 12 women were 'not eligible' by this criterion, 0 pregnant women, 5 breastfeeding, 6-7 non-breastfeeding.

As would be expected, an FFQ that 'certifies' approximately 95% of all study subjects will, by chance alone, 'correctly' certify 95% of those truly eligible. This was the case with the Harvard score. None of the chi-square or Fisher's Exact Tests were statistically significant, meaning that if one wanted to certify only 95% of the population, one would do as well by randomly picking a number from 1 to 20 as one would by using an FFQ. Neither questionnaire proved statistically able to classify correctly the remaining 5%. In only two cases was there a Fisher's Exact Test that approached significance, namely the Block FFQ for All Women and for breastfeeding women. But Table 4-17 illustrates the essential meaninglessness of such a result.

Table 4-18 summarizes the results of the analyses for this potential criterion. The p-values indicate the statistical significance of classification tables like that shown in Table 4-17 (i.e., above and below 100% of the RDA by FFQ score results) for each sample subgroup. A p-value < 0.05 would indicate an ability of the FFQ to discriminate between those who failed one or more nutrient RDAs on their diet recalls and those for whom all

five nutrients were adequate. Note that about 95% of All Women and about 85% of all children failed at least one diet recall RDA.

Conclusion: This criterion is not appropriate as an eligibility screener for WIC, nor is it helpful in identifying which FFQ may be useful for WIC eligibility decisions.

Criterion II - "A specific nutrient or nutrients below 100% of the RDA"

A second possible eligibility criterion might be to certify those who are below the RDA on particular nutrients. While providing some flexibility for WIC, the analysis is complicated by the differing nature of the two manual scoring systems. Harvard scores are based on numbers of servings from food groups. They produce a dichotomous "pass/fail" result for each of five food groups. Block scores, in contrast, produce a continuous variable for each of five nutrients (ranging, for example, from 0 to 75). Thus, several complications arise. First, one scoring system is keyed to food groups while the other is keyed to nutrients. The accuracy of the food-group-based eligibility decisions cannot be directly tested because food groups are not accessible from the diet recall data. (Some judgments can be made based on comparability with national data; see Food Groups later in this Section.) Thus, comparisons of the food-group-based Harvard scores with diet recall nutrients is not completely appropriate and does not directly reflect the intentions of the Harvard developers. Second, the Block score produces a continuous variable rather than a single dichotomous decision; the cutpoint to be used for a dichotomous decision (pass/fail) is variable and arbitrary. The cutpoint used here, in order to be able to compare the two methods with respect to dichotomous decision rules (above/below the RDA) was not based on knowledge of nutrient distributions among WIC women and children. Thus, for both manual scoring systems the methods used to test and compare them are only imperfectly appropriate or comparable.

Table 4-17

Classification of Recalls and FFQs Relevant to 100% of the RDA
Block FFQ, Breast-feeding Women

FFQ Scores	**Diet Recall Results** All nutrients ≥ 100% RDA	One or more nutrients < 100% of RDA
All manual scores indicate diet OK	**3**	**13**
1 or more scores indicate not OK	**2**	**55**

Table 4-18

Statistical Significance of Classification of Recalls and FFQ Manual Scores Relevant to ≥ 100% of the RDA*

Category	**Harvard p-values**	**Block p-values**
All Women	0.41	0.07
All Children	0.56	0.59
Pregnant	na (all < RDA)	na (all <RDA)
Breast-feeding	0.82	0.07
Not Breast-feeding	0.25	0.29
African-American	0.90	0.11
Hispanic	0.27	0.28
White	0.94	0.77

* A p-value <0.05 would indicate a manual score's ability to correctly distinguish between those with all recall nutrients above the RDA and those with one or more low nutrient levels.

The results shown in Table 4-19 assess the extent to which the manual scores can correctly categorize study subjects as above or below the RDA. Block scores were compared with their relevant nutrients. Harvard scores were compared with the nutrients most directly relevant: Dairy with calcium, Fruits with vitamin C, Vegetables with vitamin A, Meats with protein, Grains with iron. (Note that for vitamin C, Vegetables was also compared, as was the combination of Vegetables and Fruits; neither of these were as good as Fruits alone. For iron, Meats were also compared, as was the combination of Meats and Grains; neither of these was as good as Grains, except in occasional race/category groups).

Results for All Women and Children are shown below, for the Harvard "pass\fail" scores and the initially-proposed cutpoints for the Block scores. One possible evaluation of manual scoring methods concerns the proportion of the population falling below the RDA. Table 4-19 shows these proportions (as a percent) for manual scores and food recalls.

Several Harvard scores shown in Table 4-19 misestimate the proportion who are below the RDA for these nutrients. Among women, substantially too few women are detected as being low in calcium intake (78% by diet recall *vs.* 34% by manual score) and substantially too many are estimated to be low in protein (17% *vs.* 72%). The proportion "failing" on iron (Grain Products) is somewhat overestimated by the Harvard score, while vitamins C and A are within ±10% of the correct proportions, in women. In the Block manual score, for women, too few "fail" the manual score initial cutpoints for iron (55% *vs.* 78%) and vitamin A (40% *vs.* 61%); the other three nutrients are within ±10%.

Among children, all of the Harvard scores fail to estimate the correct proportion by 10% or more, in some cases substantially: whereas 0% of children had less than the RDA for protein in the diet recalls, 25% of children "fail" on the Harvard Dairy Score; 87% "failed" on the Harvard Grain Products score; 64% of children "fail" on the Harvard Meat score, and the combination of Meat and Grains scores did not improve results. In the other direction, the proportion of children with inadequate calcium was substantially underestimated (72% *vs.* 25%) by the Harvard Dairy Products score. The Block initial

Table 4-19

Percent Failing FFQ Manual Score and Percent <100% of the RDA by Nutrient for All Women and Children

All numbers are percents

Nutrient	Harvard: Diet Recall <RDA	Harvard: Failed FFQ Manual Score	Harvard: Percentage Point Difference	Block *: Diet Recall <RDA	Block *: Failed FFQ Manual Score	Block *: Percentage Point Difference
All Women						
Protein	17	72	55	23	15	8
Vitamin A	64	66	2	61	40	21
Vitamin C	32	39	7	32	24	8
Iron	72	83	11	78	55	23
Calcium	78	34	44	75	74	1
Children						
Protein	0	64	64	0	2	2
Vitamin A	25	70	45	29	43	14
Vitamin C	22	32	10	16	38	22
Iron	51	87	36	55	63	8
Calcium	72	25	47	63	58	5

* Block initial cutpoints used.

cutpoints overestimated the proportion of children with low intakes of vitamin C (38% *vs.* 16%) and vitamin A (43% *vs.* 29%), while the other three nutrients were within ±10%.

Note again, that while the Harvard scores were developed as eligibility criteria, they were not intended to be keyed to the nutrients they are compared to in this discussion, but to servings of foods. For some of the Harvard food groups a direct comparison to nutrients seems quite relevant, e.g., Dairy Products and calcium, or Meat Products and protein. On the other hand, using iron as the criterion nutrient for the Grain Products group may be less appropriate. While iron was most highly associated with the Grain Products group among the nutrients considered, other reasons to count or encourage Grain Products might include dietary fiber, or percent of energy from carbohydrates.

For the Block Score, it is also worth noting that since the scores are continuous variables, the cutpoints can be adjusted to reflect accurately the proportion below a particular nutrient RDA in the WIC population.

One assessment of the dichotomized scores involves examining whether the actual nutrient intake as measured by the diet recall data is significantly higher in the "pass" group than in the "fail" group. Table 4-20 shows these analyses for women and Table 4-21 for children. The Harvard "pass/fail" categorizations are compared with the same nutrients shown in the previous table. The Block nutrient scores are shown for above/below the initially proposed cutpoints. Among women in Table 4-20, persons identified as "failing" a score did indeed have lower intakes of the relevant nutrient than those who did not for both FFQs. (In this analysis a significant p-value indicates a successful discrimination between groups with low and high intake.) The difference in the mean nutrient intake by diet recall was significantly different ($p < 0.05$) in the pass and fail groups for all five nutrients by the Block score, and for one of the nutrients by the Harvard score, although three additional Harvard food group/nutrient comparisons approached significance.

Among children in Table 4-21, neither FFQ manual score succeeded in documenting statistically significant differences in mean nutrient intake by diet record, for any nutrient. In part, this failure to attain statistical significance is related to the smaller sample sizes in children compared with women. Persons who "failed" each of these scores did tend to have lower diet recall nutrient intake (with the exception of the Block calcium score for children). The Harvard score approached significance for calcium ($p = 0.06$) and vitamin A ($p = 0.09$). The Block score approached significance for protein ($p = 0.07$).

Examination of these data after exclusion of FFQ outliers did not alter any of these conclusions. As noted above, the Harvard scores were not designed to reflect nutrient intake exactly. For the Block scores, further exploration of cutpoints or food items to be included or excluded from the score might improve these results.

Table 4-20

Comparison of Mean Diet Recall Intake by Manual Score for All Women by FFQ Type*

		Harvard				Block	
		Fail	**Pass**			**Fail**	**Pass**
Meats, Etc.	*Mean Protein (mg)*	**79**	**82**	**Protein Score**	*Mean Protein (mg)*	**65**	**82**
	n	*170*	*65*		*n*	*34*	*200*
	p	*0.41*			*p*	*<0.01*	
Vegetables	*Mean Vitamin A (RE)*	**838**	**969**	**Vitamin A Score**	*Mean Vitamin A (RE)*	**782**	**974**
	n	*155*	*80*		*n*	*95*	*139*
	p	*0.06*			*p*	*<0.01*	
Fruits	*Mean Vitamin C (mg)*	**114**	**133**	**Vitamin C Score**	*Mean Vitamin C (mg)*	**90**	**125**
	n	*91*	*144*		*n*	*55*	*179*
	p	*0.07*			*p*	*<0.01*	
Grain Products	*Mean Iron (mg)*	**14.2**	**15.9**	**Iron Score**	*Mean Iron (mg)*	**13.5**	**15.2**
	n	*195*	*40*		*n*	*129*	*105*
	p	*0.06*			*p*	*<0.05*	
Milk Products	*Mean Calcium (mg)*	**687**	**975**	**Calcium Score**	*Mean Calcium (mg)*	**840**	**1,047**
	n	*81*	*154*		*n*	*174*	*60*
	p	*<0.01*			*p*	*<0.01*	

* A p-value <0.05 would indicate that a manual score could successfully identify a group of subjects (those who "fail") whose nutrient intake was significantly lower than those who did not "fail."

Table 4-21

Comparison of Mean Diet Recall Intake by Manual Score for Children by FFQ Type*

Harvard		Fail	Pass	Block		Fail	Pass
Meats, Etc.	Mean Protein (mg)	**46**	**50**	Protein Score	Mean Protein (mg)	**33**	**52**
	n	60	34		n	2	85
	p	0.26			p	0.07	
Vegetables	Mean Vitamin A (RE)	**606**	**729**	Vitamin A Score	Mean Vitamin A (RE)	**582**	**614**
	n	71	23		n	37	50
	p	0.09			p	0.58	
Fruits	Mean Vitamin C (mg)	**72**	**78**	Vitamin C Score	Mean Vitamin C (mg)	**76**	**84**
	n	30	64		n	33	54
	p	0.53			p	0.40	
Grain Products	Mean Iron (mg)	**10.0**	**11.1**	Iron Score	Mean Iron (mg)	**9.9**	**10.9**
	n	82	12		n	55	32
	p	0.33			p	0.20	
Milk Products	Mean Calcium (mg)	**592**	**711**	Calcium Score	Mean Calcium (mg)	**755**	**757**
	n	23	71		n	50	37
	p	0.06			p	0.97	

* A p-value <0.05 would indicate that a manual score could successfully identify a group of subjects (those who "fail") whose nutrient intake was significantly lower than those who did not "fail."

For the Block manual score, it is also possible to examine the actual nutrient intake not just within dichotomous pass/fail categories but also within quartiles of the manual scores. These are shown in Table 4-22 for All Women and Table 4-23 for children.

It can be seen in Table 4-22 that among women there is a clear relationship between the Block manual score and the associated nutrient. In general, for both means and medians, there is a linear relationship of increasing diet recall mean nutrient with increasing manual score quartile. Among children, however, that is not the case (see Table 4-23). The children's mean diet recall nutrient tends to be somewhat higher in the fourth than in the first quartile, but even that is not true when medians are examined, and there is no clearly linear relationship as there is among women.

Criterion III -"Select from a range of cut-points"

WIC State agencies require that any scoring system provide a degree of flexibility so that they may vary the criterion and thus the proportion of a population that will be certified as eligible. The flexibility afforded by the two scoring systems, Harvard and Block, is different. For the Harvard manual score, criteria for determining eligibility can be varied by requiring that one, two, or more of the food group scores must be deemed "inadequate." For the Block manual score, criteria for determining eligibility can be varied by varying the position of the cutpoint on any one of the nutrient scores.

If the scoring systems in general are reflective of intake, then WIC clinics could choose the affordable proportion who would be WIC-eligible, by choosing different possible cut-points or decision criteria of the two instruments. Tables 4-24 (Harvard women and children), 4-25 (Block women) and 4-26 (Block children) show the proportion of the WIC subjects in the present study population who would be deemed eligible by the possible criteria of the two instruments.

Table 4-22

Mean Recall Nutrients within Quartile of Manual Block FFQ Score for All Women

Block FFQ Score Category	Recall Nutrient	Quartile	Median	Mean	sd
Protein	Protein (gm)	Q 1	67.8	70.7	25.0
		Q 2	71.6	72.0	20.7
		Q 3	78.2	81.2	26.6
		Q 4	88.1	93.8	30.5
Vitamin A	Vitamin A (RE)	Q 1	566	728	528
		Q 2	857	924	496
		Q 3	805	940	466
		Q 4	814	962	518
Vitamin C	Vitamin C (mg)	Q 1	71.4	90.5	62.6
		Q 2	85.1	112.6	70.2
		Q 3	112.7	131.1	70.1
		Q 4	126.7	133.5	65.2
Iron	Iron (mg)	Q 1	11.2	12.3	4.7
		Q 2	13.8	14.4	4.6
		Q 3	14.4	14.7	6.0
		Q 4	14.5	15.6	6.1
Calcium	Calcium (mg)	Q 1	606	699	366
		Q 2	803	831	336
		Q 3	947	995	427
		Q 4	1076	1069	388

Table 4-23

Mean Recall Nutrients within Quartile of Manual Block FFQ Score for Children

Block FFQ Score Category	Recall Nutrient	Quartile	Median	Mean	sd
Protein	Protein (gm)	Q 1	53.1	52.6	15.3
		Q 2	46.5	49.6	17.5
		Q 3	49.9	51.2	12.7
		Q 4	55.8	54.3	13.0
Vitamin A	Vitamin A (RE)	Q 1	520	605	310
		Q 2	572	545	243
		Q 3	567	605	214
		Q 4	511	638	286
Vitamin C	Vitamin C (mg)	Q 1	81.8	82.5	48.4
		Q 2	73.1	73.3	29.1
		Q 3	82.2	86.5	34.3
		Q 4	70.5	82.6	45.8
Iron	Iron (mg)	Q 1	10.4	10.4	4.1
		Q 2	9.1	9.6	3.1
		Q 3	9.7	10.2	3.2
		Q 4	9.2	10.9	4.1
Calcium	Calcium (mg)	Q 1	758	766	307
		Q 2	729	762	286
		Q 3	691	720	234
		Q 4	715	784	273

Table 4-24

Harvard FFQ
Varying Criteria and Proportion Who "Fail" for All Women and Children

All Women

Possible Decision Criteria	Percent Who Fail	Cumulative Percent Failing
Fail none	4.3	---
Fail exactly one score	12.8	12.8
Fail exactly two scores	21.7	34.5
Fail exactly three scores	23.8	58.3
Fail exactly four scores	20.4	78.7
Fail exactly all scores	17.0	95.7

Children

Possible Decision Criteria	Percent Who Fail	Cumulative Percent Failing
Fail none	5.3	---
Fail exactly one score	14.9	14.9
Fail exactly two scores	16.0	30.9
Fail exactly three scores	27.7	58.6
Fail exactly four scores	27.7	86.3
Fail exactly all scores	8.5	94.8

Table 4-25

Block FFQ
Varying Criteria, and Proportion Who "Fail" for All Women

Possible Decision Criteria	Protein Score		Vitamin A Score		Vitamin C Score		Iron Score		Calcium Score	
Score Cutpoints	%	Cum. %	%	Cum. %	%	Cum. %	%	Cum. %	%	Cum. %
0-5	5.1	5.1	7.7	7.7	12.8	12.8	6.4	6.4	7.3	7.3
6	1.7	6.8	1.3	9.0	5.1	17.9	2.1	8.5	0.4	7.7
7	2.6	9.4	3.8	12.8	5.6	23.5	1.3	9.8	3.4	11.1
8	1.7	11.1	5.6	18.4	6.0	29.5	3.0	12.8	5.1	16.2
9	3.4	14.5	3.0	21.4	8.1	37.6	4.3	17.1	7.3	23.5
10	6.0	20.5	7.3	28.6	9.0	46.6	1.7	18.8	4.3	27.8
11	4.7	25.2	5.1	33.8	4.7	51.3	5.1	23.9	5.1	32.9
12	4.7	29.9	6.8	40.6	5.6	56.8	3.4	27.4	4.3	37.2
13	6.8	36.8	7.7	48.3	6.4	63.2	8.1	35.5	7.3	44.4
14	5.6	42.3	3.8	52.1	6.0	69.2	6.0	41.5	9.8	54.3
15	5.6	47.9	3.8	56.0	7.7	76.9	6.4	47.9	5.6	59.8
16	6.4	54.3	5.1	61.1	4.3	81.2	7.3	55.1	8.1	67.9
17	8.1	62.4	3.8	65.0	3.4	84.6	5.1	60.3	3.8	71.8
18	4.3	66.7	3.4	68.4	3.8	88.5	5.1	65.4	3.8	75.6
19	5.1	71.8	7.3	75.6	2.1	90.6	3.8	69.2	6.0	81.6
20	3.4	75.2	5.6	81.2	2.6	93.2	5.1	74.4	4.3	85.9
21	6.0	81.2	2.6	83.8	0.9	94.0	3.8	78.2	3.8	89.7
22	2.1	83.3	2.6	86.3	0.4	94.4	2.6	80.8	0.9	90.6
23	2.6	85.9	3.0	89 3	1.7	96.2	0.9	81.6	0.9	91.5
24	2.1	88.0	1.7	91 0	0.9	97.0	2.6	84.2	1.7	93.2
25	1.3	89.3	1.7	92 7	0.4	97.4	3.4	87.6	1.7	94.9
26 or more	10.7	100.0	7.3	100 0	2.5	100.0	12.4	100.0	5.1	100.0

Table 4-26

Block FFQ
Varying Criteria, and Proportion Who "Fail" for Children

Possible Decision Criteria Score Cutpoints	Protein Score %	Protein Score Cum. %	Vitamin A Score %	Vitamin A Score Cum. %	Vitamin C Score %	Vitamin C Score Cum. %	Iron Score %	Iron Score Cum. %	Calcium Score %	Calcium Score Cum. %
0-5	2.3	2.3	2.3	2.3	14.9	14.9	2.3	2.3	5.7	5.7
6	2.3	4.6	2.3	4.6	6.9	21.8	2.3	4.6	1.1	6.9
7	3.4	8.0	4.6	9.2	6.9	28.7	3.4	8.0	4.6	11.5
8	1.1	9.2	2.3	11.5	9.2	37.9	5.7	13.8	4.6	16.1
9	1.1	10.3	6.9	18.4	10.3	48.3	5.7	19.5	2.3	18.4
10	4.6	14.9	3.4	21.8	8.0	56.3	5.7	25.3	11.5	29.9
11	6.9	21.8	4.6	26.4	2.3	58.6	4.6	29.9	4.6	34.5
12	3.4	25.3	3.4	29.9	4.6	63.2	3.4	33.3	5.7	40.2
13	3.4	28.7	4.6	34.5	8.0	71.3	4.6	37.9	5.7	46.0
14	8.0	36.8	8.0	42.5	10.3	81.6	3.4	41.4	3.4	49.4
15	6.9	43.7	6.9	49.4	4.6	86.2	5.7	47.1	3.4	52.9
16	4.6	48.3	5.7	55.2	2.3	88.5	5.7	52.9	4.6	57.5
17	5.7	54.0	2.3	57.5	1.1	89.7	5.7	58.6	4.6	62.1
18	0.0	54.0	2.3	59.8	0.0	89.7	4.6	63.2	5.7	67.8
19	6.9	60.9	6.9	66.7	3.4	93.1	3.4	66.7	10.3	78.2
20	2.3	63.2	5.7	72.4	2.3	95.4	3.4	70.1	6.9	85.1
21	9.2	72.4	9.2	81.6	2.3	97.7	4.6	74.7	2.3	87.4
22	2.3	74.7	0.0	81.6	1.1	98.9	4.6	79.3	4.6	92.0
23	3.4	78.2	2.3	83.9	1.1	100.0	2.3	81.6	2.3	94.3
24	3.4	81.6	2.3	86.2	--	--	3.4	85.1	1.1	95.4
25	2.3	83.9	4.6	90.8	--	--	3.4	88.5	1.1	96.6
26 or more	16.1	100.0	9.1	100.0	--	--	11.5	100.0	3.4	100.0

Manual Scoring Discussion and Conclusions

Instructions for the Harvard manual score suggest that scoring can stop and an eligibility decision can be reached as soon as any food group score is "failed." That approach, however, is not useful for the WIC situation for the following reasons:

- Virtually all respondents fail and would be declared eligible, thus affording WIC no flexibility in the proportion of clients served;
- It cannot select correctly the 5% of respondents who do not fail; and

Different instructions that allow more flexibility, such as "eligible if two food groups fail," "eligible if three food groups fail," etc., were shown above in Tables 4-24 through 4-26 with the proportion who would be eligible by those definitions. The Block score, by its design, allows for a wide range of flexibility.

Scores may also be judged by whether the study subjects who "fail" do indeed have lower nutrient intake than those who do not. These were shown in Table 4-19, for the Harvard scores and the Block initial cutpoints. For women, all five Block scores differentiated pass/fail groups whose intakes were significantly different statistically; only one of the Harvard scores did so at the $p < 0.05$ level. Table 4-22 quartiles show that higher and lower levels of the Block score are associated with further differentiation among groups with high and low intake.

Among children neither manual score cutpoint was successful. If validity correlations for children can be improved, it may also be possible to improve the performance of the Block manual scoring system.

Thus, in terms of validity, flexibility, and the ability to distinguish between groups with lower or higher nutritional intake, the Block manual scoring system performed better. Improved pass/fail cutpoints for women have already been identified (Appendix E-1). Further modifications might improve the score for children.

4.7 FFQ FOOD GROUPS

Analytic Approaches

The two FFQs were compared with each other with respect to their estimates of the frequency of consumption of nine food groups of interest. In addition, the USDA Food Guide Pyramid recommendations are shown, for comparison. Food group data are not obtainable from the Minnesota Nutrient Data System (NDS), and thus a direct comparison of these estimates with the reference data was not possible. However, for some food groups an internal comparison between the accuracy of the relevant nutrient estimate and the food group estimate was considered.

Comparisons with published frequency estimates from other national data sets were not performed, but the strengths and weaknesses of such comparisons are discussed.

Food Group Definitions

Harvard FFQ. It was not possible to locate any software documentation regarding the exact food items that are included in the food groups for the Harvard food group count. As noted in the Harvard 1992 report (Gardner et al., 1992), instruments may vary widely in the foods included in a group. Listed below are the number of potentially relevant items on the Harvard questionnaire, including all those also counted by the Block software as being in that group (e.g., pizza in dairy group). This is not necessarily the number that the Harvard software counts in that group.

- *Milk, yogurt and cheese group.* 6 potential items. (Ice cream and pudding also asked.)
- *Fruit and fruit juice group.* 12 potential items.
- *Vegetables group.* 16 potential items.
- *Bread, cereal, rice & pasta group.* 12 potential items. (This does not include donuts or sweet rolls.)
- *Meat etc. group.* 16 potential items (counting same types of items as in Block meat group).

- *Foods rich in vitamin A.* 10 potential items. (Choice of foods to include in a group such as this is quite arbitrary. Only foods directly parallel to those included in the Block vitamin A group are counted here.)
- *Foods rich in vitamin C.* 4 potential items. (Choice of foods to include in a group such as this is quite arbitrary. Only foods directly parallel to those included in the Block vitamin C group are counted here)
- *Sweets.* 12 potential items.
- *Fats.* 2 potential items. Again, choice of items is somewhat arbitrary.

Block FFQ. Food groups in the Block software can be defined to include any set of foods chosen by the investigators. Thus, the groups could be defined in any way desired. For example, 'Foods rich in vitamin A" could be defined to include or exclude peaches. The definition of the food groups used in the present analysis is shown below, and includes the food group inclusions that are the defaults in the software, and represents foods included in the 'Pyramid" groups. Only foods used on the Block WIC FFQ are shown.

- *Milk, yogurt and cheese group.* 7: Whole milk, lowfat milk, cheese and cheese spread, macaroni and cheese, pizza, yogurt or frozen yogurt, milk on cereal.
- *Fruit and fruit juice group.* 7: "Apples, grapes or any other fruit," bananas, peaches or cantaloupe, oranges, orange juice, apple or grape juice, baby food fruit (child's FFQ only).
- *Vegetables group.* 12: Tomatoes, broccoli, greens or spinach, coleslaw or cabbage, carrots, green salad, sweet potatoes or yams, potatoes including French fries, other vegetables, beef stew, vegetable soup, cooked green peppers or chile rellenos.
- *Bread, cereal, rice & pasta group.* 12: Bread including sandwiches, cornbread, corn tortillas, flour tortillas, biscuits or muffins, rice, spaghetti with sauce, pizza, macaroni and cheese, cold cereals, cooked cereals or grits, hamburgers (rolls). This intentionally does not include pastries and similar high-fat or high-sugar grain products.

- *Meat etc. group*. 16: Hamburgers, beef, beef stew, liver, pork, fried chicken, other chicken, tuna, fish, hot dogs, lunch meats, eggs, bacon or sausage, dried type beans, chili with beans, peanuts or peanut butter.
- *Foods rich in vitamin A*. 7: Greens or spinach, carrots, sweet potatoes, liver, cheese or cheese spread, macaroni and cheese, eggs.
- *Foods rich in vitamin C*. 3: Oranges, orange juice, greens or spinach.
- *Sweets*. 6: Ice cream, donuts or pastry, chocolate candy, soft drinks, cake or cookies, and sugar.
- *Fats*. 2: Butter or margarine, salad dressing.

FFQ Food Groups Results

The data shown in Table 4-27 are for FFQ-1 only, that is, the first administration of the FFQ. Further, they include all study subjects in the core analyzed data set, including those whose FFQ results were thought to be questionable by the respective FFQ criteria. This subset is the one most relevant to the usability of the instruments in an actual WIC situation where dietary assessment is most frequently performed as part of eligibility determination, and computer scoring and edits are not available.

<u>Comparisons of the Two FFQs with Each Other and with the Pyramid Recommendations.</u>

<u>*Milk.*</u> Both FFQs overestimated calcium intake consistently (see Section 4.5 on group means). Thus, it is likely that both estimates of the Milk food group are overestimates. For Harvard, this could be remedied by dropping some items, or reformatting to eliminate the possibility of erroneously high estimates for the individual foods. For the Block FFQ, this could be remedied by combining Whole milk and Lowfat milk on the questionnaire, as the presence of two items may have confused some in this population.

<u>*Fruit.*</u> The Harvard FFQ significantly overestimated vitamin C (see Section 4.5 on group means). This is reflected in the substantially higher estimate of fruit by Harvard than Block. Based on national survey data, it is likely that both are

Table 4-27

Servings per Food Group and USDA Pyramid Recommendations for Harvard and Block FFQ-1, All Cases Included.

(Mean number of servings +/- sd)

Food Groups	Estimated Number of Servings Harvard FFQ	Block FFQ	Pyramid Recommendation
Meat, Poultry, Fish, Beans, Eggs	2.5 +/- 2.37	2.7 +/- 2.4	2+
Vegetables	3.8 +/- 4.0	2.5 +/- 2.3	3+
Foods Rich in Vitamin A	1.0 +/- 1.34	1.5 +/- 1.45	na
Fruit and Fruit Juice	4.1 +/- 4.96	2.0 +/- 1.74	2+
Foods Rich in Vitamin C	1.8 +/- 1.95	0.7 +/- 0.71	na
Bread, Cereal, Rice and Pasta	3.7 +/- 3.34	3.2 +/- 2.0	6+
Milk & Milk Products	3.0 +/- 2.29	3.8 +/- 2.98	2+

overestimates, but the Harvard overestimate is substantially greater. The Harvard overestimate could be moderated by reformatting, as described above, and dropping some items.

Vegetables. Both FFQs overestimate vitamin A (see Section 4.5 on group means). Thus, it is likely that both estimates of vegetable consumption are overestimates, Harvard more so than Block.

Bread, pasta, etc. Harvard's estimate is somewhat higher than Block's. The Block FFQ food group includes rice and pasta (as does the Pyramid), while the actual foods comprising the Harvard list are unknown. Both are probably underestimates of actual servings, as servings are defined by the Pyramid. This is because, in general, the food

group scores are counting instances of consumption rather than half-cup or one-slice portions.

Meat, etc. Both FFQs overestimate protein (see Section 4.5 on group means), Harvard more so than Block. The fact that Block's food group estimate is higher than Harvard's above may reflect that Block's group includes beans and eggs (as the Pyramid does), while Harvard's may not. The actual foods that comprise Harvard's group are not known.

Foods rich in vitamin A. Block's food group estimate is higher than Harvard's, but this may reflect the inclusion in the Block FFQ count of liver, cheese, macaroni and cheese, and eggs. Whether or not these foods are included in the Harvard FFQ count is not known, but it is likely that only vegetable sources were included. As noted above, for the Block FFQ the foods to be included in a food group count may be defined in advance by FNS nutritionists.

Foods rich in vitamin C. Harvard's food group estimate is higher than Block's, but again it is probably a function of the foods included in the count.

Comparisons with National Surveys

Comparisons with data from NHANES II 24-hour diet recall data have many problems, as discussed further below. However, they provide some comparison with national detailed data. In NHANES II, only 59% of the population ate even a single serving of a fruit or fruit juice. This would suggest that a low mean daily fruit intake is closer to the truth than a high one. The average number of servings of fruits and vegetables was approximately 3.5. Both of these NHANES II estimates tend to be lower in lower-income persons.

Similarly, comparisons with CSFII are imperfect. The only published CSFII data usable for this purpose give the percent of the population using a food type *at least once in four days*. Among low-income women 19-50 years, only 37.4% used any milk or milk products (including milk, cheese, yogurt and other items). CSFII data are not presented separately for pregnant or lactating women, however, and you would expect intake in those groups to be higher. In CSFII, only 91% of low-income children 1-4 and only 72%

of low-income women consumed any fruit or fruit juice in the four days, suggesting again that lower rather than higher estimates are closer to the truth.

Food Groups Discussion

Table 4-27 shows that the mean food group frequency is higher by the Block FFQ for Milk Products, Meat and Foods Rich in Vitamin A. It is higher in the Harvard FFQ for Fruit, Vegetables, Bread Products and Foods Rich in Vitamin C. The relevance of this observation is unclear, since the food group frequency depends to a great extent on the number of foods included in the group.

The USDA Food Pyramid suggests consumption of 2-4 servings of fruit and 3-5 servings of vegetables. Consumption of 5 servings of fruits and vegetables a day has been estimated to provide 225-400 mg of vitamin C per day (Lachance 1992, Patterson 1990). Since the intake of vitamin C in this WIC population is substantially below that level, it would seem that they are consuming considerably less than the five servings; this would be consistent with other national data indicating poor intakes of these foods. Again, lower estimates seem closer than higher estimates, and suggest that the Block estimates are closer to reality. The Pyramid recommends six or more servings of grain products, and both instruments suggest considerably less than that, again consistent with other data.

With regard to comparisons among the different data sources, a limitation of all comparisons is that definitions of foods to be included in the groups vary across the different national surveys and between the Harvard and Block instruments. Comparisons with NHANES II or CSFII might seem to have the merit of at least being objective estimates of actual intake. However, NHANES II refers only to intake in the prior 24 hours, whereas the FFQ refers to intake in the prior month. The CSFII four-day data provide better "usual" intake estimates than does a single 24-hour diet recall, but published data are only available for some of the food groups. And like a 24-hour diet recall, all that is known is the proportion who consumed them <u>at least</u> once during the four days, not the average <u>number</u> of times the foods were consumed. Thus, none of these comparisons provides a precise evaluation of whether or not the FFQ estimates of number of servings consumed is accurate.

Comparison of the two FFQs with food group estimates from food frequency questionnaires administered to national samples, such as the 1987 National Health Interview Survey (NHIS) or the National Cancer Institute's "Five-a-day Baseline Survey" also are fraught with difficulties. First, such comparisons exaggerate agreement of these FFQs with national data, because the national data are of the same form, a food frequency questionnaire; similarity of estimates does not necessarily mean that either one is correct. Further, an examination of the NHIS and Five-a-day questionnaires illustrates the problem of comparing numbers of servings from different instruments. The estimates from the Five-a-day survey are substantially higher than those from the NHIS data, in large part a simple result of the numbers of foods on the food list. NHIS included only 18 fruits and vegetables, while Five-a-day included 33 such items. Estimates of numbers of servings will inevitably vary depending on the number of items asked and included in the food group estimate. Inaccurately low estimates of numbers of servings from a food group can be remedied by increasing the number of foods from that food group asked on the FFQ. However, inclusion of too many food items on an FFQ does not necessarily increase the accuracy of the estimate, but rather may lead to overestimates of the number of servings consumed.

Limitations of the Usability of Food Group Estimates from the FFQs

For both FFQ instruments, the computer program must be run in order to obtain the estimate of number of servings from food groups. For the Harvard FFQ, this would be done by key-entering the FFQ responses into WICENTER. For the Block FFQ, this would be done either by key-entering or with a scanner. Both instruments produce food group estimates in the printed output. Thus, for both instruments the estimates of food group servings would only be available to the WIC nutritionist in the clinic if the instruments are computer-scored.

For purposes of data aggregation within or across WIC sites, or for subsequent research, the Block FFQ produces a computer file with the food group count on it; with the Harvard FFQ, on the other hand, the printed output would itself have to be key-entered in a second keying process if a computer file of food group results were desired.

Food Group Conclusions

The comparison of numbers of items in the groups noted above, combined with the examination of NDS and FFQ group means (Section 4.5), suggest that both FFQs overestimate intake of several food groups, and that the Harvard FFQ overestimates to a greater extent than does the Block FFQ. To some extent these overestimates could be reduced by reducing the number of food items included in the group count, particularly for the Harvard FFQ. However, to a considerable extent the Harvard FFQ overcount is a function of the structure of the FFQ itself: by permitting study subjects to indicate a frequency of consumption as high as 6+ times per day for all foods, errors of exaggeration are inevitable and consistent. A substantial reduction in Harvard's overcount would require restructuring the frequency categories. Other improvements are possible for the Block FFQ. With regard to milk and dairy products, the Block FFQ instrument for WIC should perhaps not include two line items for fluid milk, as that may have confused some study subjects and led to double-counting.

4.8 FFQ USABILITY ASSESSMENT BY WIC AGENCIES

Usability Assessment Results

State WIC agencies in Delaware, North Dakota and Puerto Rico provided qualitative assessments of the Harvard and Block FFQs. The questionnaires were used with a small number of WIC clients in each state and FFQ usability issues were examined by administering staff. The assessment was structured around a set of specific questions relating to the FFQ's effectiveness for use in nutrition education, use in determining WIC eligibility, ease of use, etc. A summary of usability assessment results is described in this section.

Usefulness for Nutrition Education

The WIC agency nutritionists who were queried indicated that both FFQs were generally useful in collecting dietary assessment information that was helpful in providing

nutrition education to WIC clients. Some believed that the Harvard FFQ food groupings related better to WIC eligibility criteria and nutrition education models such as the "food pyramid." Although the Block FFQ is also organized by types of foods, the WIC staffs generally preferred the Harvard manual score results which give a simple pass-fail on each food group, which relate more closely to commonly-used nutrition education food groups. The Block portion quantity question regarding "how much each time" proved useful for discussing portion sizes with clients.

Manual Scoring Systems

In general, all three participating agencies found the Block FFQ manual scoring system quick and easy to use whereas the Harvard scoring system, using overlays, was described as "cumbersome," "confusing," "time-consuming," and "overwhelming to the professional." On the other hand, they liked Harvard's easy, pass-fail system for rating each food group. Having the entire scoring system printed on the right-hand column of the Block FFQ was perceived as advantageous over having to keep track of three separate scoring templates. One evaluation noted that it would be preferable if the range of scoring values were consistent throughout the Block FFQ (two sets of values are used on page 4). Several WIC staff suggested that computerized scoring systems might be preferable to either of the manual approaches.

Overall, Harvard and Block scores were both perceived as useful for determining eligibility. However, the evaluating WIC staff questioned the reliability and accuracy of both FFQs. One respondent suggested including an interpretation of scores at the end of the Block FFQ. Another praised the ease of using the Harvard pass-fail food group results, but questioned the accuracy of the Harvard scores because they seem to allow almost all clients to qualify. It was thought that the Harvard food groupings relate better to WIC eligibility criteria than those of the Block instrument and also that the Harvard pass-fail scores are more easily understood by clients.

Use by WIC Clients

The three evaluating agencies expressed very mixed opinions as to which FFQ type was easier to use by WIC clients. However, there was some agreement about desirable characteristics. Both FFQs were seen as relatively easy to read and use. There was consensus that having a sample question, as in the Block FFQ, was very useful in helping orient a client to the instrument. Again, some thought the food groupings in the Harvard FFQ were more logical and made more sense to clients and WIC staff. It was agreed that the FFQs should be as short as possible and there was concern expressed about the length and complexity of both Harvard and Block FFQs. Some reviewers said that the Block portion question about how much of each item was consumed each time — small, medium, or large — was ambiguous and confusing to some clients. Others liked the assessment of children's portion sizes in the Block FFQ which asks how much each time "compared to other children."

In general, both Harvard and Block FFQs were cited as being graphically clear, simple and easy-to-read. The use of shading for food item lines and frequency columns in both instruments was noted as aiding usability. It was also considered advantageous that both FFQs ask users only to check boxes as opposed to writing out responses.

FFQ Administration by WIC Staff

A concern with both FFQs was the amount of time needed to instruct clients on how to complete the questionnaires. Even after explanations, some clients were confused about how to proceed or complete the FFQ. Staff valued having a sample question for demonstration purposes included at the start of the Block FFQ. As noted, most staff preferred the simpler Block scoring system to the Harvard, finding it easier to score and taking less time.

Cultural Suitability

The evaluating WIC staff thought that both FFQs were suitable for use with African Americans, Hispanics and Whites. However, the Puerto Rico WIC program expressed serious concern about the applicability of either FFQ for use with its all-

Hispanic, Spanish-speaking population. It was reported that Puerto Rican clients were confused about how to use and complete the FFQs and did not understand general questions about frequencies and quantities. Furthermore, many of the food terms in Spanish are not used nor understood in Puerto Rico. The diversity of Hispanic food terms suggests that it may be difficult to utilize only one version of a Spanish-language FFQ with all Hispanic groups.

Assessment Summary

Overall, the three participating WIC agencies who were queried for their opinions about usability thought that both FFQs proved generally useful in collecting dietary assessment information and assisting in nutrition education. The validity for using these FFQs to determine eligibility was questioned and some WIC staff thought that it may be more effective and less time-consuming to collect diet recalls. Neither FFQ worked well with the Puerto Rican WIC population for a variety of cultural reasons.

Reviewers preferred to have a manual scoring system incorporated into the instrument as in the Block FFQ and disliked having to use the separate Harvard scoring templates. On the other hand, they preferred to have easy-to-interpret scores, as with the Harvard instrument, that relate to commonly perceived food groups.

The structure and logic related to constructing food frequency questionnaires may not be obvious to WIC staff. Some participating in the assessment were puzzled by the selection of specific food items included in the FFQs, feeling that they did not seem to be representative. They also questioned why some relatively nutritious foods, such as broccoli and vitamins, are not assigned scores in the Block system, while other foods, such as ketchup, French fries and donuts, merit positive nutrient scores.

The manual scoring systems may not entirely serve the purposes of the clinic nutritionist who conducts a more comprehensive nutrition education effort beyond the level of determining strictly WIC eligibility. For example, it was felt that the manual scores do not help evaluate dietary intake of nutrients such as fats, sodium and fiber, and that such assessments were important to more complete counseling. These nutrients are in fact captured by the FFQs, but are not reflected in the current manual scoring systems.

SECTION 5 - FUTURE WORK

The present study has identified some positive results regarding the usefulness of FFQs in the WIC context. However, a number of questions and possibilities remain.

5.1 FURTHER EXAMINATIONS IN THE EXISTING DATA SET

With the data collected for this study, several further analyses can be used to improve the instruments. Most of these possible further analyses, with the exception of the last one in this section, could be conducted at fairly little additional effort.

Analyses Aimed at Improving the FFQ

In the Block FFQ

Reformatting Frequency Categories It is recommended that some of the frequency response categories be revised before any further use of this FFQ. Such a revision will reduce the overestimation of vitamin C and calcium intake.

Manual Scores Other cutpoints for the manual scores could be investigated. The cutpoints in the analyses shown in Section 4.5 were arbitrary, based on estimates derived from published CSFII data. Cutpoints that reflect more accurately the proportion of women with intake below the RDA were also developed based on the existing diet recall data (See Appendix E-1). Additionally, Tables 4-14 and 4-17 in the same section should be redone to evaluate whether the diet recall means in the resulting pass/fail groups are still significantly different.

Food Groups As noted in Section 4.7, Food Groups, foods to be included in the food group estimates are definable by the user. Thus, one could specify the foods which should be included in each food group, based on dietary recommendations or health education. For example, one could elect to have only fruits and vegetables in the group "Foods rich in vitamin A". Table 4-21 in Section 4.7 showing average servings from each food group could then be repeated using groups more in line with program needs.

Improving the Calcium Estimate. The Block FFQ overestimated calcium. This overestimate may in part be the result of the two milk lines on the Block FFQ (whole and low-fat). It is likely that some women were confused by the two lines, and double-counted. It is possible to rerun the Block nutrient estimates, telling the program to ignore one of the two milks. In addition, the frequency categories for milk could be redefined. The calcium estimates would likely be lower and closer to the diet recall estimates. Correlations could also be rerun to determine whether or not this change to the FFQ might improve the calcium estimates. Other explorations of sources of overestimations could be investigated, such as those described below.

Improving the Vitamin A Estimate. The Block FFQ overestimated vitamin A. This may be the result of including too many vitamin A rich foods on the list. The Nutrient Sources program in the Block software can be run, which produces a ranked list of foods in order of their contribution of vitamin A among WIC respondents to this FFQ. The nutrient estimates could then be rerun, omitting the least important foods. It would be essential to recalculate not only the resulting group means, but also the correlation coefficients. One would not want to omit a food from the FFQ if it reduced the correlations, regardless of whether or not it reduced the overestimates.

Improving the Protein Estimate. The same procedure described for vitamin A, above, could be repeated to identify a better food list for protein (if improvement was still needed after correction of the milk estimate).

Improving the Iron Estimate. Unlike other nutrients, the Block FFQ underestimated iron intake. This appears to be due to differences in the nutrient databases used for the study. The NDS database assumes higher iron content for baked goods than does the Block database. Revisions should be investigated.

Vitamin Supplement Correlations. It is critical to examine correlations inclusive of vitamin supplements as well as exclusive of them. With supplements excluded it is possible to evaluate the performance of the FFQs among persons who do not take supplements, and is consonant with FNS' emphasis on foods. However, two-thirds of the WIC population did take supplements, and supplement sources comprise a significant component of their nutrient intake. Thus, to fully evaluate the total nutrient intake of WIC

clients, and the performance of FFQs in assessing total nutrient intake, correlations in which the supplement sources were included should also be examined.

Edit Criteria. The current computerized edit criteria for identifying questionable Block FFQ respondents and improving the nutrient estimates were described in Section 3. These have been widely used and proved useful in other analyses. However, some modifications might improve the nutrient estimates produced by the FFQ. In particular, the edit program permits "unreasonably" high frequency estimates for particular foods to remain, if there is only one such estimate in an FFQ. The remaining one food could, however, produce erroneously high estimates for particular nutrients. The edit program can be modified to handle these situations. In addition, the merits of using edit criteria relating to unusually high or low energy estimates can be investigated. The Block software automatically calculates a variable called "Outlier," which already exists on the file. Questionnaires that are too high or too low by those criteria could be temporarily dropped and the correlations rerun, to examine whether those flags would be more useful than the current edit criteria in identifying questionable respondents.

In Both the Harvard and Block FFQ

Both FFQs Substantially Overestimate Some Nutrients. This may be in part because there are too many foods on the food list. In the Block software the least important foods can be identified. If nutrient content and portion size assumptions in the Harvard FFQ were made available, it would also be possible to run the Harvard FFQ through the Block software, in order to identify the ranked Nutrient Sources. This would make it possible to identify which foods should be omitted from the FFQs in order to reduce overestimation.

In addition to the probability of having too many foods on the food list, another source of misestimates is related to the fact that some respondents check off the highest frequencies of consumption permitted. In the Harvard FFQ, each food on the FFQ can be reported to be consumed as many as six times per day. One exploratory analysis might examine the number of foods checked as "5/day" or "6+/day", separately by ethnic group. The Harvard FFQ overestimate was greater among Hispanics than among the other ethnic

groups. For example, among African Americans the diet recall mean energy was 2,211 kcal vs. Harvard FFQ 2,747; but among Hispanics the diet recall mean was 1,810 kcal vs. the Harvard FFQ mean of 3,220. It is likely that this overestimate was caused in part by numerous responses of "6+/day," and that in turn these substantial overestimates produced a wider range which was the source of the higher correlations seen for Harvard Hispanics (see Section 4.4). Block FFQ estimates were also higher for Hispanics than for the other ethnic groups, although not significantly so in any case. The proportion answering "2+/day," the highest Block category, could also be examined.

Analyses Aimed at Investigating Sources of Error in the Diet recall Data

As noted elsewhere, it is likely that one source of misestimates in the diet recall data is portion size estimation using the two-dimensional models. It would be of interest, in a sample of respondents, to replace the respondent's food model selection with a standard portion. Nutrient estimates from the diet recalls would then be recalculated, and the correlations with FFQ data re-examined. It is likely that the resulting correlations would be higher than those presented in Section 4.4, at least in part because severe misestimates in the reference data had been eliminated.

5.2 SUGGESTIONS FOR FUTURE RESEARCH

Development and Testing of FFQs for Hispanics

The present study did not find adequate correlations among Hispanics to justify encouraging self-administered FFQ use among WIC Hispanics at the present time. It should be emphasized that it is not completely clear that all or even the majority of the fault lies with the FFQs, but with either difficulties in self-administration or with the reference data. Thus, one worthwhile project would be to repeat the validation study in Hispanics, but administer the FFQ by interview. It is possible that even one of the FFQs studied here would have proved adequate, if administered by interviewer. It should be remembered that one-third of the Hispanic women in this study had six years of education or less, and many were probably only marginally literate, even in Spanish.

As noted elsewhere, the difficulty of collecting good reference data in this group may have been an important source of poor correlations. Thus, any future research should emphasize that part of the data collection. A future study on Hispanics should include the following components in obtaining the diet recall data:

- In-person interviews to obtain diet recall data;
- Bilingual and bicultural interviewers;
- Possibly not three-dimensional models for portion size in the recall data, but either a more detailed (weighed duplicates or in-home viewing by interviewer) or less detailed (standard portions or small-medium-large) approach to portion size;
- Careful collection of recipe data for mixed dishes, and careful ascertainment of the portion consumed by the respondent; and
- Data collected separately in the three major Hispanic ethnic groups.

If administration by interview still results in poor correlations, a more extensive developmental study might be undertaken.

Reconsideration of FFQ Development for Hispanics

Study components should include:

- Food list development based on results of ethnic-specific diet recall data collected as above. It is possible that both the foods on the list and the nutrient content of those foods might differ in different ethnic groups;
- Mixed dishes on food list, based on diet recall data above. It is possible that the nutrient content of such mixed dishes might vary in different ethnic groups;
- Focus groups to enhance intelligibility of FFQ form;
- It is possible that separate translations, or possibly even separate food lists, should be developed for different ethnic subgroups of Hispanics. Although it is likely that the same food list could be used, it may be that different translations would be desirable. In the present study, all ethnic-specific wording for all three ethnic subgroups was printed on the questionnaire. That is, if there was a different term for a food among Mexican Americans and Puerto Rican

Americans, both were printed on the questionnaire. This may have been one more linguistic complexity that confused respondents with little education; and

- A validation study should compare self-administered with interviewer-administered questionnaires.

Finally, because the literacy problem may limit the use of FFQs in Hispanics in WIC, no matter how well-developed the FFQs, FNS might consider exploring briefer instruments for this population. These would have to be administered by WIC nutritionists or aides and would not be intended to make nutrient estimates. However, they could be rigorously developed to provide useful data despite being substantially shorter than a full FFQ.

Development and Testing of FFQs for Children

The present study did not find correlations that would justify encouraging FFQ use to ascertain children's diets from mothers or caregivers. It is possible that the poor correlations may be an effect not just of FFQ limitations, but also of limitations in the reference data. Still more important may be the questionable ability of any caregiver to report accurately on the diet of a child who may not be exclusively in that person's care. It is possible that no method can be relied on, whether FFQ or 24-hour diet recall. Often, in today's society, children are not under their parents' direct observation 24 hours a day. Grandparents, neighbors, friends, siblings, baby-sitters or various child care arrangements are a reality. Even if it were possible, in a research study, to determine what the child had in fact eaten, caregivers may always be limited in their ability to report it accurately because they are not always with the child. It is possible that it may be preferable to relinquish the goal of obtaining full nutrient data regarding small children by any method. Instead, it may be that a small number of behavioral questions ("fruit every day?", "glasses of milk?") would serve WIC's purposes better.

SECTION 6 - CONCLUSIONS

6.1 HARVARD VS. BLOCK

As noted in Section 4.3 (Validity Correlations), the ability to identify where individuals lie along the distribution from low to high intake is the most important criterion measure for the validity of a food frequency questionnaire. By this criterion, the Block FFQ had higher correlations than the Harvard FFQ for almost three-fourths of the comparisons shown in Table 4-8. Among African Americans and Whites, 9 of 12 Block correlations were at or above 0.40, while only 1 of 12 Harvard correlations was that high. By the second administration of the FFQs, Block still had higher correlations than Harvard for most of the comparisons. Thus, in terms of the validity of the instruments, the results in Section 4.3 indicate that the Block FFQ is the more valid instrument.

Although accurate estimation of group means is not an appropriate criterion for judging FFQs, it is an added benefit when it occurs. With few exceptions, the Block medians and means were closer to their respective recall values than were Harvard's, and fewer of the Block means were significantly different from the recall means.

In terms of error-proneness of the estimates, the Harvard FFQ is substantially more error-prone. For example, 13% of all Harvard respondents (20% of Harvard Hispanics) were excluded because of energy estimates exceeding 4,500 kcal; only 8 (3.4%) of the Block respondents had an energy estimate that high. Estimates of vitamin C in excess of 500 mg/day were seen in 6.4% of Harvard women and 0.9% of Block women. (For comparison, the NHANES II 95th percentile for vitamin C was 290 mg.)

The Harvard manual score and instructions declare almost all respondents to be "eligible", and do not identify correctly those who are not in fact eligible. The Block manual score affords more flexibility, and distinguishes those with low and high intakes better than does the Harvard score. Further improvements in the Block score are planned.

In summary, this study indicates that the Block FFQ produces more valid nutrient estimates than does the Harvard FFQ, and the Block manual score is both more valid and more flexible.

6.2 UTILITY TO THE WIC PROGRAM

Regardless of relative merits of the two FFQs, it is appropriate to ask whether either one is sufficiently valid to be useful in WIC, and for what groups.

White and African American Women

For Whites and African-Americans, the correlation data suggest that the Block FFQ is adequately valid, with most correlations in excess of 0.40, and some in excess of 0.50. After correction for day-to-day variability in the recalls, some correlations reached 0.60 or higher. Although the correlations were lower than that found in most validations of the Block instrument (Block et al., 1990a, 1990b, 1992; Cummings et al., 1987; Sobell et al., 1989; Mares-Perlman et al., 1993), they indicate a fairly useful level of validity. This is particularly true when one considers the nature of the reference data. In this population there appeared to be considerable error in the reference (recall) data, which would itself be a source of lowered correlations.

The manual scoring system for women also appeared adequately able to identify groups with lower and higher nutrient status, and provides the flexibility needed by WIC. For those who prefer a single pass/fail, the score cutpoints tested here performed adequately, and can be revised to improve that performance still further. Also, since the system has demonstrated its validity, it would be possible to devise similar manual scoring systems for other nutrients.

Hispanic Women

For Hispanic women, neither FFQ can be recommended to assess dietary intake in a self-administered format at the present time (they could be used as a basis for providing nutrition education). Because of literacy issues, it is possible that no self-administered full

food frequency questionnaire can be recommended in this group in the fairly near future. However, it is possible that administration by interviewer could provide useful information, and it could serve as a focus for nutrition education, so long as nutrients or manual scores are not calculated or used for eligibility. It is also possible that reference data collection and FFQ design can be improved, and Section 5 suggests some approaches to that end.

Children 1-4

For caregivers of children 1-4, neither FFQ can be recommended to assess dietary intake at the present time. Brief simple behavioral questions may be more appropriate for WIC's purposes for this age group. However, the FFQ could be a useful tool for this group as a focus for nutrition education, as long as nutrient or manual score estimates are not calculated or used.

Feasibility, Acceptability

Both FFQs were completed in under 10 minutes by White and African-American respondents, with little assistance. Manual scoring was accomplished by the aide in three minutes. The three WIC agencies consulted about usability of the FFQs for nutrition education provided the following conclusions or suggestions:

- The portion size section of the Block FFQ may be useful in nutrition education about portion sizes; and
- Both instruments could be useful in nutrition education.

Some reviewers felt the Block manual score's focus on nutrients did not mesh well with the WIC nutrition education focus on food groups. (It should be noted, however, that the Task Force on Nutritional Assessment in the WIC Program explicitly recommended a system keyed to the RDAs.) A focus on food groups can be achieved by providing WIC nutritionists with instructions on how to use the score to focus their own attention on possible problem nutrients, and then to conduct nutrition education of the client by pointing to specific foods or food groups on the questionnaire itself.

Computer scoring of the FFQs produces estimates of more than 30 nutrients and percent of energy from macronutrients, servings from the pyramid food groups (Block FFQ), and other data. Keying of either FFQ can be done in approximately five minutes. In the future, some WIC clinics may have scanners available, in which case the complete nutrient estimates can be produced, without keying, in just a few minutes. The latter approach, use of a scanner to analyze the Block FFQ in an actual WIC clinic, was tested and found to be logistically feasible, by Jacobson et al. (1990) in evaluations in the Florida WIC program. Thus, full dietary evaluations of a wide range of nutritional factors are feasible in the future for WIC agencies. If and when this becomes possible, it would permit widespread data collection in the WIC system, as well as extensive health research on maternal and child outcomes in relation to nutritional intake.

SECTION 7 - REFERENCES

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APPENDIX A

BLOCK FOOD FREQUENCY QUESTIONNAIRE

- Cover Page for Block FFQ (Women's English Version)
- Block FFQ for Women (English Version)
- Block FFQ for Women (Spanish Version)
- Block FFQ for Children (English Version)
- Block FFQ for Children (Spanish Version)

The Block Food Frequency Questionnaires can be purchased from:

Dr. Gladys Block
419 Warren Hall
University of California at Berkeley
Berkeley, California 94720
(510) 643-7896
Fax (510) 643-6981

Foods You Ate in the Past 4 Weeks

Your Name: ______________________________

This form will take about 15 minutes to complete.

OMB Disclosure Statement

Public reporting burden for this collection of information is estimated to vary from 10 - 25 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Agriculture Clearance Officer OIRM. Room, 404-W. Washington, D.C. 20250; and to the Office of Management and Budget Paperwork Reduction Project (OMB NO 0578-0018), Washington, D.C. 20503.

AWE | 1 | | | | | | |

Scale 75% of original

Foods You Ate in the Past 4 Weeks

- This form asks about some of the foods you ate in the past 4 weeks. Remember to include meals and snacks eaten at home or out.

- For every food, please mark with an "X" how often you ate that food. *For example, if you drank orange juice twice a week in the past 4 weeks, put an "X" in the box under "2 per week" (see example below).*

- Please tell us how much of that food you usually eat each time. Put an "X" under "How Much Each Time?" for small, medium, or large. Is the amount small, medium or large compared to other women your age? *Look at the example below for a large glass of orange juice.*

- For some foods the "How Much" will be very specific. *For example, if you ate bread twice a day and usually had about one slice each time, you would put an "X" over the "1" for 1 slice (see example).*

Example:

How Often in the Past 4 Weeks? / How Much Each Time?

Foods You Ate in the Past 4 Weeks	Almost Never	PER MONTH: 1 time last month	PER MONTH: 2-3 last month	PER WEEK: 1 time per week	PER WEEK: 2 per week	PER WEEK: 3-4 per week	PER WEEK: 5-6 per week	PER DAY: 1 per day	PER DAY: 2+ per day	AMOUNT: Small	AMOUNT: Medium	AMOUNT: Large
Orange juice					X							X
Bread, including sandwiches, bagels and burger rolls									X	Slices (each time) X 1	2	3+

Scale 75% of original

Do Not Write Below

How Often in the Past 4 Weeks?

How Much Each Time?

	Foods You Ate in the Past 4 Weeks	Almost Never	PER MONTH		PER WEEK				PER DAY		AMOUNT		
			1 time last month	2-3 last month	1 time per week	2 per week	3-4 per week	5-6 per week	1 per day	2+ per day	Small	Medium	Large
1	Bananas												
2	Oranges												
3	Peaches, cantaloupe												
4	Apples, grapes or any other fruit												

		Almost Never	PER MONTH		PER WEEK				PER DAY		AMOUNT		
			1 time last month	2-3 last month	1 time per week	2 per week	3-4 per week	5-6 per week	1 per day	2+ per day	Small	Medium	Large
5	Tomatoes												
6	Broccoli												
7	Greens, spinach												
8	Cole slaw, cabbage												
9	Carrots												
10	Green salad												
11	Salad dressing												
12	Potatoes including French fries												
13	Sweet potatoes, yams												
14	Cooked green peppers, chile rellenos												
15	Any other vegetable												
		0	0	0	1	1	2	2	3	4			

Page 1

Vit C	Vit A	Prot	Iron	Calc

Scale 75% of original

Do Not Write Below

How Often in the Past 4 Weeks? How Much Each Time?

Foods You Ate in the Past 4 Weeks	Almost Never	PER MONTH: 1 time last month	PER MONTH: 2-3 last month	PER WEEK: 1 time per week	PER WEEK: 2 per week	PER WEEK: 3-4 per week	PER WEEK: 5-6 per week	PER DAY: 1 per day	PER DAY: 2+ per day	AMOUNT: Small	AMOUNT: Medium	AMOUNT: Large
16 Cooked cereals, grits												
17												
18 Milk on cereal												
19										Eggs 1	2	3+
20 Bacon, sausage, links										Pieces 1	2	3+

	Almost Never	PER MONTH: 1 time last month	PER MONTH: 2-3 last month	PER WEEK: 1 time per week	PER WEEK: 2 per week	PER WEEK: 3-4 per week	PER WEEK: 5-6 per week	PER DAY: 1 per day	PER DAY: 2+ per day	AMOUNT: Small	AMOUNT: Medium	AMOUNT: Large
21 Spaghetti with tomato sauce												
22 Hamburgers, cheeseburgers, beef burritos, tacos												
23 Beef (steak or roast), ribs												
24 Mixed dishes with beef like beef stew												
25 Liver including chicken liver												
26 Pork, pork chops, roasts												
27 Fried chicken												
28 Other chicken (stewed, baked or roasted)												
29 Tuna sandwich or tuna casserole												
30 Fish, fish sandwich												
	0	0	0	1	1	2	2	3	4			

Page 2

Vit C Vit A Prot Iron Calc

Scale 75% of original

Do Not Write Below

How Often in the Past 4 Weeks? How Much Each Time?

Foods You Ate in the Past 4 Weeks		Almost Never	PER MONTH 1 time last month	2-3 last month	PER WEEK 1 time per week	2 per week	3-4 per week	5-6 per week	PER DAY 1 per day	2+ per day	AMOUNT
31	Beans like pinto or refried beans										Small / Medium / Large
32	Rice										Small / Medium / Large
33	Chili with meat or beans (American style)										Small / Medium / Large
34	Vegetable soup, tomato soup										Small / Medium / Large
35	Any other soup										Small / Medium / Large
36	Pizza										Slices 1 | 2 | 3+
37	Lunch meats, sliced ham										Slices 1 | 2 | 3+
38	Hot dogs										Hot Dogs 1 | 2 | 3+

		Almost Never	PER MONTH 1 time last month	2-3 last month	PER WEEK 1 time per week	2 per week	3-4 per week	5-6 per week	PER DAY 1 per day	2+ per day	AMOUNT
39	Biscuits, muffins										Small / Medium / Large
40	Corn bread, corn muffins										Small / Medium / Large
41	Margarine or butter										Small / Medium / Large
42	Cheese and cheese spread										Small / Medium / Large
43	Mixed dishes with cheese, macaroni and cheese										Small / Medium / Large
44	Salsa, taco sauce, ketchup, hot red peppers										Small / Medium / Large
45	Bread, including sandwiches, bagels and burger rolls										Slices (each time) 1 | 2 | 3+
46	Corn tortillas										Tortillas (each time) 1 | 2 | 3+
47	Flour tortillas										Tortillas (each time) 1 | 2 | 3+
		0	0	0	1	1	2	2	3	4	

Vit C | Vit A | Prot | Iron | Calc

Page 3

Scale 75% of original

Do Not Write Below

How Often in the Past 4 Weeks?

How Much Each Time?

Foods You Ate in the Past 4 Weeks

	Foods	Almost Never	PER MONTH: 1 time last month	PER MONTH: 2-3 last month	PER WEEK: 1 time per week	PER WEEK: 2 per week	PER WEEK: 3-4 per week	PER WEEK: 5-6 per week	PER DAY: 1 per day	PER DAY: 2+ per day	AMOUNT: Small	AMOUNT: Medium	AMOUNT: Large
48	Chips, popcorn, crackers, pork skins												
49													
50	Ice cream or pudding												
51													
52	Donuts, pastry												
53													
54	Chocolate candy, candy bars												
		0	0	0	1	1	2	2	3	4			

	Foods	Almost Never	1-3 times last month	PER WEEK: 1 time per week	PER WEEK: 2-4 per week	PER WEEK: 5-6 per week	PER DAY: 1 per day	PER DAY: 2 per day	PER DAY: 3-4 per day	PER DAY: 5-6 per day	AMOUNT: Small	AMOUNT: Medium	AMOUNT: Large
55	Orange juice												
56	Apple juice, grape juice												
57	Kool-Aid, fruit drinks, Hi-C												
58	Lowfat and skim milk (not including milk on cereal)												
59	Regular milk (not including milk on cereal)												
60	Milk or cream in coffee or tea												
61	Regular soft drinks (not diet soda)												
62	Beer (all types)												
63	All types of wine, wine coolers												
64	Liquor (all types)												
65	Sugar in coffee, tea or on cereal (not sugar substitutes)										Teaspoons 1	2	3+
		0	0	0	1	2	3	4	5	6			

Page 4

Vit C | Vit A | Prot | Iron | Calc

Scale 75% of original

Do Not Write Below

During the past 4 weeks, how many pills did you usually take?

Multiple Vitamins

	Multiple Vitamins	None	PER WEEK 1-3 per week	PER WEEK 4-6 per week	PER DAY 1 per day	PER DAY 2 per day	PER DAY 3 per day	PER DAY 4 per day	PER DAY 5+ per day
66	Prenatal vitamins								
67	Multiple vitamins like One-a-Day tablets								

Single Vitamins

	Single Vitamins	None	PER WEEK 1-3 per week	PER WEEK 4-6 per week	PER DAY 1 per day	PER DAY 2 per day	PER DAY 3 per day	PER DAY 4 per day	PER DAY 5+ per day
68	Iron pills								
69	Calcium pills								
70	Vitamin E pills								
71	Vitamin C pills								

		100	250	500	1000	Don't Know
72	If you take Vitamin C, how many milligrams of Vitamin C is in each tablet?					

Thank you for completing this form!

	Vit C	Vit A	Prot	Iron	Calc
Page 1					
Page 2					
Page 3					
Page 4					
TOTAL					

Scale 75% of original

Alimentos Que Usted Comió en las Ultimas 4 Semanas

- Este cuestionario le pregunta sobre algunos de los alimentos que usted comió en las últimas 4 semanas. Acuérdese de incluir comidas y meriendas/entre comidas dentro y afuera de su casa.

- Para cada alimento, por favor marque con una "X" debajo de la casilla que indica que tan seguido usted comió ese alimento. *Por ejemplo, si usted bebió jugo de naranja dos veces por semana en las últimas 4 semanas, marque con una "X" en la casilla bajo "2 por semana" (vea el ejemplo que sigue).*

- Por favor dejenos saber la cantidad de ese alimento que se come cada vez. ¿Es la cantidad pequeña, mediana o grande comparada con otras mujeres de su edad? Marque con una "X" bajo "¿Cuánto Cada Vez?", escogiendo entre Chico, Mediano y Grande. *Fíjese en el ejemplo que sigue para un vaso de jugo de naranja grande.*

- Para algunos alimentos, "¿Cuánto Cada Vez?" será muy específico. *Por ejemplo, si usted comió pan dos veces al día y usualmente se comió una rebanada cada vez, usted marca con una "X" sobre el "1" por una rebanada (vea el ejemplo que sigue).*

Ejemplo:

¿Qué Tan Seguido en las Ultimas 4 Semanas? — ¿Cuánto Cada Vez?

Comidas Que Comió en las Ultimas 4 Semanas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
Jugo de naranja/china					X							X
Pan incluyendo sandwiches, bagels y pan de hamburguesa									X	¿Cuánto cada vez? X	2	3+

Scale 75% of original

Por Favor No Escriba Abajo

¿Qué Tan Seguido en las Ultimas 4 Semanas?

¿Cuánto Cada Vez?

Comidas Que Comió en las Ultimas 4 Semanas

			POR MES		POR SEMANA				POR DIA		CUANTO		
		Casi Nunca	1 vez en el mes pasado	2-3 en el mes pasado	1 vez por semana	2 por semana	3-4 por semana	5-6 por semana	1 por día	2+ por día	Chico	Mediano	Grande
1	Plátanos/guineos/bananos												
2	Naranjas/chinas												
3	Melocotones/duraznos o melón cantalupo												
4	Manzanas, uvas u otra fruta												

			POR MES		POR SEMANA				POR DIA		CUANTO		
		Casi Nunca	1 vez en el mes pasado	2-3 en el mes pasado	1 vez por semana	2 por semana	3-4 por semana	5-6 por semana	1 por día	2+ por día	Chico	Mediano	Grande
5	Tomates												
6	Broccoli/brecol												
7	Espinaca												
8	Ensalada de col, repollo												
9	Zanahorias												
10	Ensalada de lechuga												
11	Aderezo para ensalada, o mayonesa, aliño												
12	Papas incluyendo papas fritas												
13	Batatas, ñames, camotes												
14	Chile rellenos												
15	Cualquier otra verdura/vegetal												
		0	0	0	1	1	2	2	3	4			

Page 1

Vit C Vit A Prot Iron Calc

Scale 75% of original

Por Favor No Escriba Abajo

¿Qué Tan Seguido en las Ultimas 4 Semanas?

¿Cuánto Cada Vez?

Comidas Que Comió en las Ultimas 4 Semanas

#	Comidas Que Comió en las Ultimas 4 Semanas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
16	Cereal cocido												
17	Cereales fríos, como Cheerios, con o sin leche												
18	Leche en cereal												
19	Huevos/blanquillos										Huevos 1	2	3+
20	Tocineta/tocino, salchichas										¿Cuánto? 1	2	3+

#	Comidas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
21	Espagheti con salsa de tomate												
22	Hamburguesas, hamburguesas con queso, burritos de res, tacos												
23	Bistec o rosbif/carne de res, costillas												
24	Caldo de res												
25	Higado incluyendo higado de pollo												
26	Cerdo incluyendo chuletas, asados, puerco/marrano												
27	Pollo frito												
28	Otro pollo (pollo en caldo, horneado o asado)												
29	Sandwich de atun o "tuna casserole"												
30	Pescado o sandwich de pescado												
		0	0	0	1	1	2	2	3	4			

Page 2

Vit C	Vit A	Prot	Iron	Calc

Scale 75% of original

Por Favor No Escriba Abajo

¿Qué Tan Seguido en las Ultimas 4 Semanas?

¿Cuánto Cada Vez?

Comidas Que Comió en las Ultimas 4 Semanas

	Comidas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por dia	POR DIA: 2+ por dia	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
31	Frijoles como frijol pinto o refritos o habichuelas												
32	Arroz												
33	"Chili con carne" estilo americano												
34	Sopa o caldo de verduras/vegetales o tomates sin res o pollo												
35	Otras sopas o caldos												
36	Pizza										Rebanadas 1	2	3+
37	Jamón, fiambres, carnes frías, carne de lonche										Rebanadas 1	2	3+
38	Hot dog/perro caliente										Hot Dogs 1	2	3+

	Comidas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por dia	POR DIA: 2+ por dia	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
39	Panecillos, bizcochos/bisquetes												
40	Pan de maiz, panecillos de maiz												
41	Margarina o mantequilla												
42	Queso y queso crema												
43	Platillos con queso incluyendo macarrón con queso												
44	Salsa, ketchup, chiles rojos picantes												
45	Pan incluyendo sandwiches, bagels y pan de hamburguesa										Cada vez 1	2	3+
46	Tortillas de maiz/masa										Tortillas (cada vez) 1	2	3+
47	Tortillas de harina										Tortillas (cada vez) 1	2	3+

Page 3

Vit C	Vit A	Prot	Iron	Calc

Scale 75% of original

Por Favor No Escriba Abajo

¿Qué Tan Seguido en las Ultimas 4 Semanas? / ¿Cuánto Cada Vez?

Comidas Que Comió en las Ultimas 4 Semanas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
48 Bocaditos salados como papitas fritas, palomitas de maíz, chicharrón de puerco												
49 Maníes/cacahuates, mantequilla de maní/crema de cacahuate												
50 Helado/nieve/mantecado, budín/pudín												
51 Yogurt o yogurt congelado												
52 Donas, pan dulce												
53 Pastel, tortas, galletas												
54 Dulce de chocolate												
	0	0	0	1	1	2	2	3	4			

	Casi Nunca	1-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2 por día	POR DIA: 3-4 por día	POR DIA: 5-6 por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
55 Jugo de naranja/china												
56 Jugo de manzana o de uva												
57 Kool-Aid o bebidas de fruta, aguas frescas												
58 Leche descremada/"lowfat" (sin incluir leche en cereal)												
59 Leche entera/"whole" (sin incluir leche en cereal)												
60 Leche o crema con café o té												
61 Sodas (sin incluir sodas de dieta)												
62 Cerveza												
63 Todo tipo de vino, "wine coolers"												
64 Licor, todo tipo de licor												
65 Azucar en cafe, te o con cereal (sin incluir azucar de dieta)												
	0	0	0	[illegible]	2	3	4	5	6			

Page 4

Vit C Vit A Prot Iron Calc

Scale 75% of original

Por Favor No Escriba Abajo

¿Durante las últimas 4 semanas, cuántas píldoras se tomó usualmente?

Vitaminas Múltiples

		Ninguna	POR SEMANA 1-3 por semana	POR SEMANA 4-6 por semana	POR DIA 1 por día	POR DIA 2 por día	POR DIA 3 por día	POR DIA 4 por día	POR DIA 5+ por día
66	Vitaminas prenatales								
67	Vitaminas múltiples como Vitamina Una al Día								

Vitaminas Individuales

		Ninguna	POR SEMANA 1-3 por semana	POR SEMANA 4-6 por semana	POR DIA 1 por día	POR DIA 2 por día	POR DIA 3 por día	POR DIA 4 por día	POR DIA 5+ por día
68	Píldoras/tabletas de hierro								
69	Píldoras/tabletas de calcio								
70	Vitamina E								
71	Vitamina C								

		100	250	500	1000	No Sé
72	¿Si usted toma Vitamina C, cuántos miligramos de Vitamina C tiene cada píldora?					

¡Gracias por completar este cuestionario!

	Vit C	Vit A	Prot	Iron	Calc
Page 1					
Page 2					
Page 3					
Page 4					
TOTAL					

Scale 75% of original

Foods Your Child Ate in the Past 4 Weeks

- This form asks about some of the foods your child ate in the past 4 weeks. Remember to include foods eaten at day care or with relatives or friends.

- For every food, please mark with an "X" how often your child ate that food. *For example, if your child drank orange juice twice a week in the past 4 weeks, put an "X" in the box under "2 per week" (see example below).*

- Please tell us how much of that food your child usually eats each time. Is the amount small, medium or large compared to other children of the same age? Put an "X" under "How Much Each Time?" for small, medium, or large. *Look at the example below for a large glass of orange juice.*

- For some foods the "How Much" will be very specific. *For example, if your child ate bread twice a day and usually had about one slice each time, you would put an "X" over the "1" for 1 slice (see example).*

Example:

How Often in the Past 4 Weeks? / Compared to Other Children How Much Each Time?

Foods Your Child Ate in the Past 4 Weeks	Almost Never	PER MONTH: 1 time last month	PER MONTH: 2-3 last month	PER WEEK: 1 time per week	PER WEEK: 2 per week	PER WEEK: 3-4 per week	PER WEEK: 5-6 per week	PER DAY: 1 per day	PER DAY: 2+ per day	AMOUNT: Small	AMOUNT: Medium	AMOUNT: Large
Orange juice					X							X
Bread, including sandwiches, bagels and burger rolls									X	Slices (each time) X	2	3+

Scale 75% of original

Child's Name:______________________________

Foods Your Child Ate in the Past 4 Weeks

How Often in the Past 4 Weeks?

Compared to Other Children How Much Each Time?

			PER MONTH		PER WEEK				PER DAY		AMOUNT		
		Almost Never	1 time last month	2-3 last month	1 time per week	2 per week	3-4 per week	5-6 per week	1 per day	2+ per day	Small	Medium	Large
1	Bananas												
2	Oranges												
3	Peaches, cantaloupe												
4	Baby food fruit												
5	Apples, grapes or any other fruit												

			PER MONTH		PER WEEK				PER DAY		AMOUNT		
		Almost Never	1 time last month	2-3 last month	1 time per week	2 per week	3-4 per week	5-6 per week	1 per day	2+ per day	Small	Medium	Large
6	Tomatoes												
7	Broccoli												
8	Greens, spinach												
9	Cole slaw, cabbage												
10	Carrots												
11	Green salad												
12	Salad dressing												
13	Potatoes including French fries												
14	Sweet potatoes, yams												
15	Cooked green peppers, chile rellenos												
16	Any other vegetable												
		0	0	0	1	1	2	2	3	4			

Do Not Write Below

Vit C	Vit A	Prot	Iron	Calc

Page 1

Scale 75% of original

Child's Name: ______________________________

Do Not Write Below

How Often in the Past 4 Weeks?

Compared to Other Children How Much Each Time?

Foods Your Child Ate in the Past 4 Weeks

	Foods	Almost Never	PER MONTH 1 time last month	2-3 last month	PER WEEK 1 time per week	2 per week	3-4 per week	5-6 per week	PER DAY 1 per day	2+ per day	AMOUNT Small	Medium	Large
17	Cooked cereals, grits, hot baby food cereals												
18	Cold cereals, such as Cheerios, with or without milk												
19	Milk on cereal												
20	Sugar on cereal										Teaspoons 1	2	3+
21	Eggs										Eggs 1	2	3+
22	Bacon, sausage, links										Pieces 1	2	3+

	Foods	Almost Never	PER MONTH 1 time last month	2-3 last month	PER WEEK 1 time per week	2 per week	3-4 per week	5-6 per week	PER DAY 1 per day	2+ per day	AMOUNT Small	Medium	Large
23	Spaghetti with tomato sauce												
24	Hamburgers, cheeseburgers, beef burritos, tacos												
25	Beef (steak or roast), ribs												
26	Mixed dishes with beef like beef stew												
27	Liver including chicken liver												
28	Pork, pork chops, roasts												
29	Fried chicken												
30	Other chicken (stewed, baked or roasted)												
31	Tuna sandwich or tuna casserole												
32	Fish, fish sandwich												
		0	0	0	1	1	2	2	3	4			

Page 2

Vit C Vit A Prot Iron Calc

Scale 75% of original

Child's Name:________________________________

How Often in the Past 4 Weeks?

Compared to Other Children How Much Each Time?

Foods Your Child Ate in the Past 4 Weeks	Almost Never	PER MONTH 1 time last month	PER MONTH 2-3 last month	PER WEEK 1 time per week	PER WEEK 2 per week	PER WEEK 3-4 per week	PER WEEK 5-6 per week	PER DAY 1 per day	PER DAY 2+ per day	AMOUNT
33 Beans like pinto or refried beans										Small / Medium / Large
34 Rice										Small / Medium / Large
35 Chili with meat or beans (American style)										Small / Medium / Large
36 Vegetable soup, tomato soup										Small / Medium / Large
37 Any other soup										Small / Medium / Large
38 Pizza										Slices 1 / 2 / 3+
39 Lunch meats, sliced ham										Slices 1 / 2 / 3+
40 Hot dogs										Hot Dogs 1 / 2 / 3+

	Almost Never	PER MONTH 1 time last month	PER MONTH 2-3 last month	PER WEEK 1 time per week	PER WEEK 2 per week	PER WEEK 3-4 per week	PER WEEK 5-6 per week	PER DAY 1 per day	PER DAY 2+ per day	AMOUNT
41 Biscuits, muffins										Small / Medium / Large
42 Corn bread, corn muffins										Small / Medium / Large
43 Margarine or butter										Small / Medium / Large
44 Cheese and cheese spread										Small / Medium / Large
45 Mixed dishes with cheese, macaroni and cheese										Small / Medium / Large
46 Salsa, taco sauce, ketchup, hot red peppers										Small / Medium / Large
47 Bread, including sandwiches, bagels and burger rolls										Slices (each time) 1 / 2 / 3+
48 Corn tortillas										Tortillas (each time) 1 / 2 / 3+
49 Flour tortillas										Tortillas (each time) 1 / 2 / 3+
	0	0	0	1	1	2	2	3	4	

Page 3

Do Not Write Below

Vit C | Vit A | Prot | Iron | Calc

Scale 75% of original

Child's Name:______________________

Do Not Write Below

Compared to Other Children How Much Each Time?

How Often in the Past 4 Weeks?

Foods Your Child Ate in the Past 4 Weeks

		Almost Never	PER MONTH 1 time last month	PER MONTH 2-3 last month	PER WEEK 1 time per week	PER WEEK 2 per week	PER WEEK 3-4 per week	PER WEEK 5-6 per week	PER DAY 1 per day	PER DAY 2+ per day	AMOUNT Small	AMOUNT Medium	AMOUNT Large
50	Chips, popcorn, crackers, pork skins												
51	Peanuts, peanut butter												
52	Ice cream or pudding												
53	Yogurt, frozen yogurt (including lowfat)												
54	Donuts, pastry												
55	Cake, cookies												
56	Chocolate candy, candy bars												
		0	0	0	1	1	2	2	3	4			

		Almost Never	1-3 times last month	PER WEEK 1 time per week	PER WEEK 2-4 per week	PER WEEK 5-6 per week	PER DAY 1 per day	PER DAY 2 per day	PER DAY 3-4 per day	PER DAY 5-6 per day	AMOUNT Small	AMOUNT Medium	AMOUNT Large
57	Orange juice												
58	Apple juice, grape juice												
59	Kool-Aid, fruit drinks, Hi-C												
60	Lowfat and skim milk (not including milk on cereal)												
61	Regular milk (not including milk on cereal)												
62	Regular soft drinks (not diet soda)												
		0	0	0	1	2	3	4	5	6			

Page 4

Vit C	Vit A	Prot	Iron	Calc

Scale 75% of original

Child's Name: ____________________

Do Not Write Below

During the past 4 weeks, how many pills did your child usually take?

Multiple Vitamins
Pills, chewable tablets or liquid

		None	PER WEEK 1-3 per week	PER WEEK 4-6 per week	PER DAY 1 per day	PER DAY 2 per day	PER DAY 3 per day	PER DAY 4 per day	PER DAY 5+ per day
63	Multiple vitamins like One-a-Day tablets, children's vitamins								

Single Vitamins
Pills, chewable tablets or liquid

		None	PER WEEK 1-3 per week	PER WEEK 4-6 per week	PER DAY 1 per day	PER DAY 2 per day	PER DAY 3 per day	PER DAY 4 per day	PER DAY 5+ per day
64	Iron pills								
65	Calcium pills								
66	Vitamin E pills								
67	Vitamin C pills								

		100	250	500	1000	Don't Know
68	If your child takes Vitamin C, how many milligrams of Vitamin C is in each tablet?					

Thank you for completing this form!

	Vit C	Vit A	Prot	Iron	Calc
Page 1					
Page 2					
Page 3					
Page 4					
TOTAL					

Scale 75% of original

Alimentos Que Su Niño/a Comió en las Ultimas 4 Semanas

- Este cuestionario le pregunta sobre algunos de los alimentos que su niño/a se comió en las últimas 4 semanas. Acuérdese de incluir los alimentos que se hayan comido en la guardería infantil o con familiares o amistades.

- Para cada alimento, por favor marque con una "X" debajo de la casilla que indica que tan seguido su niño/a comió ese alimento. *Por ejemplo, si su niño/a bebió jugo de naranja dos veces a la semana en las últimas 4 semanas, marque con una "X" en la casilla debajo de "2 por semana" (vea el ejemplo que sigue).*

- Por favor dejenos saber la cantidad de ese alimento que su niño/a se come cada vez. ¿Es la cantidad pequeña, mediana o grande comparada con otros niños de la misma edad? Marque con una "X" bajo "¿Cuánto Cada Vez?", escogiendo entre Chico, Mediano y Grande. *Fíjese en el ejemplo que sigue para un vaso de jugo de naranja grande.*

- Para algunos alimentos, "¿Cuánto Cada Vez?" será muy específico. *Por ejemplo, si su niño/a comió pan dos veces al día y usualmente se comió una rebanada cada vez, usted marca con una "X" sobre el "1" por una rebanada (vea el ejemplo que sigue).*

Ejemplo:

¿Qué Tan Seguido en las Ultimas 4 Semanas?

Comparado a otros niños ¿Cuánto Cada Vez?

Comidas Que Su Niño/a Comió en las Ultimas 4 Semanas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
Jugo de naranja/china					X							X
Pan incluyendo sandwiches, bagels y pan de hamburguesa									X	¿Cuánto cada vez? X 1	2	3+

Scale 75% of original

Nombre del Niño/a: ______________________

Por Favor No Escriba Abajo

¿Qué Tan Seguido en las Ultimas 4 Semanas?

Comparado a otros niños ¿Cuánto Cada Vez?

	Comidas Que Su Niño/a Comió en las Ultimas 4 Semanas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
1	Plátanos/guineos/bananos												
2	Naranjas/chinas												
3	Melocotones/duraznos o melón cantalupo												
4	Comida de niño fruta												
5	Manzanas, uvas u otra fruta												

		Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
6	Tomates												
7	Broccoli/brecol												
8	Espinaca												
9	Ensalada de col, repollo												
10	Zanahorias												
11	Ensalada de lechuga												
12	Aderezo para ensalada, o mayonesa, aliño												
13	Papas incluyendo papas fritas												
14	Batatas, ñames, camotes												
15	Chile rellenos												
16	Cualquier otra verdura/vegetal												
		0	0	0	1	1	2	2	3	4			

Page 1

Vit C	Vit A	Prot	Iron	Calc

Scale 75% of original

Por Favor No Escriba Abajo

Nombre del Niño/a: ______________________

¿Qué Tan Seguido en las Ultimas 4 Semanas?

Comparado a otros niños ¿Cuánto Cada Vez?

	Comidas Que Su Niño/a Comió en las Ultimas 4 Semanas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
17	Cereal cocido, comida de niños cereal caliente												
18	Cereales fríos, como Cheerios, con o sin leche												
19	Leche en cereal												
20	Azúcar en cereal										Cucharaditas 1	2	3+
21	Huevos/blanquillos										Huevos 1	2	3+
22	Tocineta/tocino, salchichas										¿Cuánto? 1	2	3+

		Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
23	Espagheti con salsa de tomate												
24	Hamburguesas, hamburguesas con queso, burritos de res, tacos												
25	Bistec o rosbif/carne de res, costillas												
26	Caldo de res												
27	Hígado incluyendo hígado de pollo												
28	Cerdo incluyendo chuletas, asados, puerco/marrano												
29	Pollo frito												
30	Otro pollo (pollo en caldo, horneado o asado)												
31	Sandwich de atún o "tuna casserole"												
32	Pescado o sandwich de pescado												
		0	0	0	1	1	2	2	3	4			

Page 2

Vit C	Vit A	Prot	Iron	Calc

Scale 75% of original

Nombre del Niño/a: ______________________________

¿Qué Tan Seguido en las Ultimas 4 Semanas?

Comparado a otros niños ¿Cuánto Cada Vez?

Por Favor No Escriba Abajo

	Comidas Que Su Niño/a Comió en las Ultimas 4 Semanas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
33	Frijoles como frijol pinto o refritos o habichuelas												
34	Arroz												
35	"Chili con carne" estilo americano												
36	Sopa o caldo de verduras/ vegetales o tomates no incluyendo res o pollo												
37	Otras sopas o caldos												
38	Pizza										Rebanadas 1	2	3+
39	Jamón, fiambres, carnes frías, carne de lonche										Rebanadas 1	2	3+
40	Hot dog/perro caliente										Hot Dogs 1	2	3+

		Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
41	Panecillos, bizcochos/ bisquetes												
42	Pan de maíz, panecillos de maíz												
43	Margarina o mantequilla												
44	Queso y queso crema												
45	Platillos con queso incluyendo macarrón con queso												
46	Salsa, ketchup, chiles rojos picantes												
47	Pan incluyendo sandwiches, bagels y pan de hamburguesa										Cada vez 1	2	3+
48	Tortillas de maíz/masa										Tortillas (cada vez) 1	2	3+
49	Tortillas de harina										Tortillas (cada vez) 1	2	3+
		0	0	0	1	1	2	2	3	4			

Page 3

Vit C | Vit A | Prot | Iron | Calc

Scale 75% of original

Nombre del Niño/a: ____________________

Comparado a otros niños ¿Cuánto Cada Vez?

¿Qué Tan Seguido en las Ultimas 4 Semanas?

Comidas Que Su Niño/a Comió en las Ultimas 4 Semanas

	Comidas Que Su Niño/a Comió en las Ultimas 4 Semanas	Casi Nunca	POR MES: 1 vez en el mes pasado	POR MES: 2-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2 por semana	POR SEMANA: 3-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2+ por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
50	Bocaditos salados como papitas fritas, palomitas de maíz, chicharrón de puerco												
51	Maníes/cacahuates, mantequilla de maní/crema de cacahuate												
52	Helado/nieve/mantecado, budín/pudín												
53	Yogurt o yogurt congelado												
54	Donas, pan dulce												
55	Pastel, tortas, galletas												
56	Dulce de chocolate												
		0	0	0	1	1	2	2	3	4			

		Casi Nunca	1-3 en el mes pasado	POR SEMANA: 1 vez por semana	POR SEMANA: 2-4 por semana	POR SEMANA: 5-6 por semana	POR DIA: 1 por día	POR DIA: 2 por día	POR DIA: 3-4 por día	POR DIA: 5-6 por día	CUANTO: Chico	CUANTO: Mediano	CUANTO: Grande
57	Jugo de naranja/china												
58	Jugo de manzana o de uva												
59	Kool-Aid o bebidas de fruta, aguas frescas												
60	Leche descremada/"lowfat" (sin incluir leche en cereal)												
61	Leche entera/"whole" (sin incluir leche en cereal)												
62	Sodas (sin incluir sodas de dieta)												
		0	0	0	1	2	3	4	5	6			

Por Favor No Escriba Abajo

Vit C Vit A Prot Iron Calc

Scale 75% of original

Por Favor No Escriba Abajo

Nombre del Niño/a: ____________________

¿Durante las últimas 4 semanas, cuántas píldoras usualmente tomó su niño/a?

Vitaminas Múltiples
Píldoras, tabletas, o en liquido

		Ninguna	POR SEMANA 1-3 por semana	POR SEMANA 4-6 por semana	POR DIA 1 por día	POR DIA 2 por día	POR DIA 3 por día	POR DIA 4 por día	POR DIA 5+ por día
63	Vitaminas múltiples como Vitamina Una al Día, vitaminas para niños								

Vitaminas Individuales
Píldoras, tabletas, o en liquido

		Ninguna	POR SEMANA 1-3 por semana	POR SEMANA 4-6 por semana	POR DIA 1 por día	POR DIA 2 por día	POR DIA 3 por día	POR DIA 4 por día	POR DIA 5+ por día
64	Píldoras/tabletas de hierro								
65	Píldoras/tabletas de calcio								
66	Vitamina E								
67	Vitamina C								

		100	250	500	1000	No Sé
68	¿Si su niño/a toma Vitamina C, cuántos miligramos de Vitamina C tiene cada píldora?					

¡Gracias por completar este cuestionario!

	Vit C	Vit A	Prot	Iron	Calc
Page 1					
Page 2					
Page 3					
Page 4					
TOTAL					

Scale 75% of original

APPENDIX B

HARVARD FOOD FREQUENCY QUESTIONNAIRE

- Harvard FFQ Administration Instructions
- Harvard FFQ Manual Scoring Templates
- Cover Page for Harvard FFQ (Women's English Version)
- Harvard FFQ for Women (English Version)
- Harvard FFQ for Women (Spanish Version)
- Harvard FFQ for Children (English Version)
- Harvard FFQ for Children (Spanish Version)

Important Note: The actual Harvard Women's and Children's questionnaires have the alternate items printed on a shaded background to facilitate reading across the frequency response categories. This is an important design feature which, unfortunately, could not be faithfully photo-copied on the examples printed in this Appendix. The questionnaires used in this validation study, obtained directly from Harvard School of Public Health, had the shaded items on them. An example of alternate shaded items can be seen on the Block FFQs in Appendix A.

The Harvard Food Frequency Questionnaires can be purchased from:

Dr. Jane Gardner
Department of Maternal and Child Health
Harvard School of Public Health
677 Huntington Avenue
Boston, Massachusetts 02115
(617) 432-1080
Fax (617) 432-3755
E-mail:JGardner@HSPH.HARVARD.EDU

Recommended Verbal Instruction for Administering the Women's and Children's Food Frequency Questionnaires

1. Fill in the client identification information in the upper right hand corner. Be sure to fill this in completely as the information is necessary to carry out the analyses.

2. Provide the appropriate questionnaire, clipboard, and pencil. Say to the woman,

   "This is the form we would like you to fill out. It has three sides. We want you to think about what you ate (or your child ate) during the last <u>four weeks</u>. We know you can't remember exactly, but you probably have a good idea."

   Read the direction on the form aloud while pointing to them.

   "You select how often you ate the food from zero times in the last four weeks to six or more times each day," [point to the scale above the column].

   "Suppose you (or your child) drank one glass of milk [point to milk] everyday [point to per day]. Then you put an X or a check here [point]. This column is for foods you had just one to three times in the last four weeks [point]."

   "We are asking about <u>serving</u> of food, not tastes. So if you put an X here [point to ice cream, 6+/day], that would say that you had eaten six or more bowls of ice cream every day for the past four weeks. Use this column only for foods you ate a lot of every day. Remember to make a mark in this column [never] if you <u>did not</u> eat the food. It helps you to keep your place and it helps us to know that you did not forget a food."

3. Watch as the client fills out the first three foods to be sure she understands the instructions.

4. Collect the finished form and check for errors in completion, i.e., pages or rows not filled in, double marked rows, number of eggs.

Scale 75% of original

Template to Score Women's and Children's Nutrition Questionnaires

Please Follow the Directions in the Order Given

Milk Products and Fruits

1. Place this template on Page 1 so that the two shaded boxes show through the holes in the template.
2. Count the checks in each column, and write the numbers in the boxes beneath each column.
3. Using the colors above the boxes and the numbers in the boxes, compare with the following combinations for a match working from right to left. Once a match is found, mark the shaded box on the questionnaire with the symbol in the gray box (X or -) next to the matched combination.

   In the combinations, any number that crosses two or more small boxes is the TOTAL of those small boxes.
4. Once you have marked the shaded box, go to the next food group.*

Milk Products Combinations

4								-
					≥1			X
				≥2	0			X
			≥2	1	0			X
		≥1	1	1	0			X
	2	0	1	1	0			X
			≥3	0	0			X
No match								-

Fruits Combinations

≥10								-
					≥1			X
			≥2		0			X
		≥4	1		0			X
	≥1	3	1		0			X
	≥3	2	1		0			X
	≥5	1	1		0			X
	≥7	0	1		0			X
		≥7	0		0			X
	≥2	6	0		0			X
	≥4	5	0		0			X
	≥6	4	0		0			X
	8	3	0		0			X
No match								-

---

* The shaded box with the mark [X] indicates the minimum intake has been met or exceeded.
  The shaded box with the mark [-] indicates the minimum intake has not been met.

Scale 75% of original

Vegetables

1. Place this template on Page 2 so that the shaded box shows through the hole in the template.
2. Count the checks in each column, and write the numbers in the boxes beneath each column.
3. Multiply the number in the box under B2 by 2. Add that result to the number in the box under B1, and write the sum in the circle.
4. Using the colors above the boxes, the numbers in the boxes, and the circle, compare with the following combinations for a match working from right to left. Once a match is found, mark the shaded box on the questionnaire with the symbol in the gray box (X or -) next to the matched combination.

   In the combinations, any number that crosses two or more small boxes is the TOTAL of those small boxes.
5. Once you have marked the shaded box go to the next food group.*

Vegetables Combinations

≥5	( )		0	0	-
	( )			≥2	X
	( )		≥1	1	X
	( )		≥3	0	X
	( )	≥2	2	0	X
	(≥2)	1	2	0	X
	(≥7)	0	2	0	X
	( )	≥3	1	0	X
	(≥2)	2	1	0	X
	(≥9)	1	1	0	X
	(≥14)	0	1	0	X
	( )	≥5	0	0	X
	(≥1)	4	0	0	X
	(≥6)	3	0	0	X
	(≥11)	2	0	0	X
	(≥16)	1	0	0	X
	(≥21)	0	0	0	X
No match					-

		B1	B2			

= B1 + (B2 × 2)

* The shaded box with the mark [X] indicates the minimum intake has been met or exceeded. The shaded box with the mark [-] indicates the minimum intake has not been met.

Scale 75% of original

Meats

1. Place this template on Page 3 so that the shaded box shows through the hole in the template.

2. Count the checks in each column, and write the numbers in the boxes beneath each column.

3. Make an adjustment for eggs by adding 1 to the number of one box, as shown below:

```
Number of       Women      Children
eggs/wk
---------------------------------------
1               None      [+1|    ]
2 or 3          [+1|   ]  [  |+1  ]
4               [  |+1 ]  [  |+1  ]
5 or more       [  |+1 ]  [  |    |+1|  ]
```

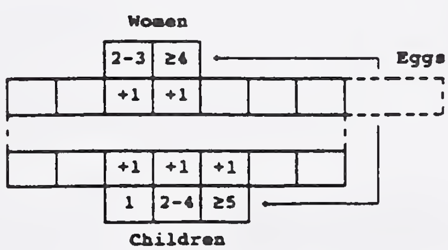
4. Using the colors above the boxes and the numbers in the boxes, compare with the following combinations for a match working from right to left. Once a match is found, mark the shaded box on the questionnaire with the symbol in the gray box (X or -) next to the matched combination.

   In the combinations, any number that crosses two or more small boxes is the TOTAL of those small boxes.

5. Once you have marked the shaded box, go to the next food group.*

Meats Combinations

≥6				0	0	-
					≥1	X
				≥2	0	X
			≥2	1	0	X
		≥1	1	1	0	X
	≥2	0	1	1	0	X
			≥3	0	0	X
		≥2	2	0	0	X
	≥2	1	2	0	0	X
	≥4	0	2	0	0	X
		≥5	1	0	0	X
	≥1	4	1	0	0	X
	≥3	3	1	0	0	X
	≥5	2	1	0	0	X
	7	1	1	0	0	X
		≥7	0	0	0	X
	≥2	6	0	0	0	X
	4	5	0	0	0	X
No match						-



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* The shaded box with the mark [X] indicates the minimum intake has been met or exceeded.
The shaded box with the mark [-] indicates the minimum intake has not been met.

Scale 75% of original

Grains

1. Place this template on Page 3 so that the shaded box shows through the hole in the template.
2. Count the checks in each column, and write the numbers in the boxes beneath each column.
3. Using the colors above the boxes and the numbers in the boxes, compare with the following combinations for a match working from right to left. Once a match is found, mark the shaded box on the questionnaire with the symbol in the gray box (X or -) next to the matched combination.

   In the combinations, any number that crosses two or more small boxes is the TOTAL of those small boxes.

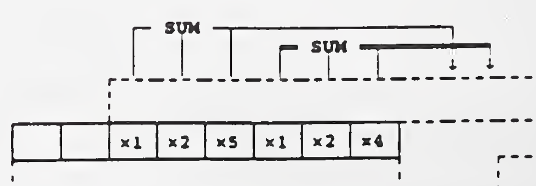
Grains Combinations 1

≥5					0			-
							≥1	X

4. If you have marked the shaded box, stop.* Otherwise, continue the following steps.
5. Multiply the numbers in the boxes by the numbers shown on the template, and write the results in the circles above the boxes. Add the values in the circles under the yellow, and write the sum in the white box. Add the values in the circles under the green, and write the sum in the box under the blue.
6. Compare the numbers in the white box and the box under the blue with the following combinations for a match working from right to left. Once a match is found, mark the shaded box on the questionnaire with the symbol in the gray box (X or -) next to the matched combination.
7. Once you have marked the gray box, stop.*

Grains Combinations 2

	≥6	X
≥7	5	X
≥14	4	X
≥21	3	X
≥28	2	X
≥35	1	X
≥42	0	X
No match		-



* The shaded box with the mark [X] indicates the minimum intake has been met or exceeded.
The shaded box with the mark [-] indicates the minimum intake has not been met.

Scale 75% of original

Foods You Ate in the Past 4 Weeks

Your Name: ______________________________

This form will take about 15 minutes to complete.

OMB Disclosure Statement

Public reporting burden for this collection of information is estimated to vary from 10 - 25 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Agriculture Clearance Officer OIRM. Room, 404-W. Washington, D.C. 20250; and to the Office of Management and Budget Paperwork Reduction Project (OMB NO 0578-0018), Washington, D.C. 20503.

BWE 5

Scale 75% of original

Name ____________
ID ____________
Date ____________
DOB ____________
Pregnant [ ]
EDC ____________
Breastfeeding 1st 6 months [ ]
Breastfeeding 2nd 6 months [ ]
Not Breastfeeding [ ]

Women's Nutrition Questionnaire

What Have You Been Eating Lately?

During the past 4 weeks, how often did you eat a serving of each of the foods listed here?

Mark only one X for each food

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Milk										1
Hot chocolate										2
Cheese, plain or in sandwiches										3
Yogurt										4
Ice cream										5
Pudding										6

What kind of milk do you drink?

[ ] whole

[ ] lowfat

[ ] skim

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Orange or grapefruit										7
Orange juice or grapefruit juice										8
Apple juice										9
Other fruit drinks (Hi-C, Kool-aid, lemonade)										10
Banana										11
Apple or applesauce										12
Grapes										13
Peaches										14
Strawberries										15
Cantaloupe										16
Watermelon										17
Pineapple										18
Raisins or prunes										19

Scale 75% of original

Mark only one X for each food

How often did you eat a serving of these foods during the past 4 weeks?

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Corn										20
Peas (canned, frozen, or fresh)										21
Tomatoes										22
Peppers (green, red, hot)										23
Carrots										24
Broccoli										25
Green beans										26
Spinach										27
Greens (mustard, turnip, collards)										28
Squash, orange or winter										29
French fries, fried potatoes										30
Potatoes (baked, boiled, or mashed)										31
Sweet potatoes or yams										32
Cabbage or coleslaw										33
Lettuce salad										34
Salad dressing or mayonnaise										35

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Chips (potato, corn, others)										36
Nuts										37
Cookies or brownies										38
Cake or cupcake										39
Pie (pumpkin, sweet potato, or squash)										40
Other pie										41
Jello										42
Chocolate candy										43
Other candy										44
Coffee or tea										45
Soft drinks										46
Sugar-free soft drinks										47

Scale 75% of original

Mark only one X for each food

How often did you eat a serving of these foods during the past 4 weeks?

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Baked beans or chili beans										48
Other dried beans, peas, or Lima beans										49
Rice										50
Spaghetti or other pasta with sauce										51
Pizza										52
Macaroni and cheese										53
Hot dogs										54
Hamburgers, meatballs, or meatloaf										55
Canned tuna										56
Cold cuts (baloney, ham, salami)										57
Peanut butter										58
Bread, toast, or rolls										59
Margarine or butter										60
Chicken or turkey										61
Pork chops, roast pork, or ribs										62
Steak or roast beef										63
Fish										64
Liver										65
Sausage										66
Bacon										67
Hot cereal or grits										68
Cold breakfast cereal										69
Donut										70
Sweet roll or muffin										71
Pancake, waffle, or French toast										72
English muffin or bagel										73
Biscuit										74
Cornbread or tortillas										75
Vegetable soup										76
Other soup										77
Crackers										78

How many eggs do you eat in one week? ______________________

Scale 75% of original

Cuestionario de Nutrición de Mujeres

Nombre ____________________
ID ____________________
Fecha ____________________
Fecha de Nacimiento ____________
Embarazada [ ]
EDC ____________
Dió el Pecho [ ]
Los primeros 6 meses
Dió el Pecho [ ]
Los segundos 6 meses
No Dió el Pecho [ ]

¿Qué ha estado usted comiendo últimamente?

¿Durante las últimas 4 semanas, qué tan a menudo comió usted una porción de cada alimento en la lista que sigue?
Marque solamente una X por cada comida

	últimas 4 semanas		cada semana			cada día				
Numero de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
Leche										1
Chocolate caliente										2
Queso, sólo o en sandwich										3
Yogurt										4
Helado, nreve										5
Budín, pudín										6

¿Qué clase de leche bebe usted?
[ ] leche entera
[ ] leche parcialmente descremada (lowfat)
[ ] leche descremada o desnatad (nonfat)

	últimas 4 semanas		cada semana			cada día				
Numero de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
China (naranja) o toronja										7
Jugo de china (naranja) o jugo de toronja										8
Jugo de manzana										9
Otros jugos de frutas (Hi-C, Kool-aid, lemonada)										10
Guineo, plátano o banano										11
Manzana o puré de manzana										12
Uvas										13
Melocotón, durazno										14
Fresas										15
Melón										16
Sandía, melón de agua										17
Piña										18
Pasas o ciruelas										19

Scale 75% of original

Marque solamente una X por cada comida

¿Qué tan a menudo comió usted una porción de ellos alimentos en las últimas 4 semanas?

	últimas 4 semanas		cada semana			cada día				
Número de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
Maíz, elote										20
Guisante, chícharo (enlatado, congelado o fresco)										21
Tomates										22
Pimientos (verde, rojo o picante)										23
Zanahoria										24
Broccoli o brecol										25
Habichuelas verde, ejote										26
Espinaca										27
Verduras (nabo o acelga)										28
Calabaza										29
Papas fritas										30
Papas (asada o hervida o en puré)										31
Batata o ñame, camote										32
Repollo o ensalada de col										33
Ensalada de lechuga										34
Aderezo para ensalada o mayonesa										35

	últimas 4 semanas		cada semana			cada día				
Número de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
Papitas fritas, doraditas, chips de maíz o otras										36
Nueces										37
Galletas										38
Bizcocho, bizcochito redondo, pastel										39
Pastel, pie o empanada (calabaza o camote)										40
Otro pastel, pie o empanada										41
Jaleas, mermeladas										42
Dulce de chocolate										43
Otros dulces										44
Cafe o té										45
Refrescos										46
Refrescos sin azúcar										47

Scale 75% of original

Marque solamente una X por cada comida

¿Qué tan a menudo comió usted una porción de ellos alimentos en las últimas 4 semanas?

	últimas 4 semanas		cada semana			cada día				
Numero de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
Habichuelas asadas con chile, frijoles guisados										48
Otras habichuelas, frijoles secos, guisante, chícaro o haba										49
Arroz										50
Espaguetti u otra pasta con salsa										51
Pizza										52
Macarrones con queso										53
Hot dog										54
Hamburguesa, albondiga o carne mechada, deshebrada										55
Atún de lata										56
Fiambres (bologna, jamón, salami), carnes frías										57
Mantequilla de maní, cacahuate										58
Pan, tostado o bolillos										59
Margarina o mantequilla										60
Pollo o pavo										61
Chuletas, carne de res o costillas										62
Bistec o rosbif										63
Pescado										64
Hígado										65
Salchichas										66
Tocino										67
Cereal caliente, avena o atole										68
Cereal frío para el desayuno										69
Donas										70
Pan dulce										71
Panque, hot cakes o French toast										72
English muffin o bagel										73
Bizcocho, bisquetes										74
Pan de maiz o tortilla										75
Sopa de verdura, caldo de verdura										76
Otras sopas, caldos										77
Galletas saladas										78

¿Cuántos huevos come usted en una semana? ____________________

Scale 75% of original

Children's Nutrition Questionnaire

Name ________________
ID ________________
Date ________________
DOB ________________
Age ________________
Respondent
Mother [ ]
Other [ ] ________________

What Has Your Child Been Eating Lately?

During the past 4 weeks, how often did your child eat a serving of each of the foods listed here?

Mark only one X for each food

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Milk										1
Hot chocolate										2
Cheese, plain or in sandwiches										3
Yogurt										4
Ice cream										5
Pudding										6

What kind of milk does your child drink?

[ ] whole
[ ] lowfat
[ ] skim

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Orange										7
Orange juice										8
Apple juice										9
Other fruit drinks (Hi-C, Kool-aid, lemonade)										10
Banana										11
Apple or applesauce										12
Grapes										13
Peaches										14
Strawberries										15
Cantaloupe										16
Watermelon										17
Pineapple										18
Raisins										19

Scale 75% of original

Mark only one X for each food

How often did your child eat a serving of these foods during the past 4 weeks?

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Corn										20
Peas (canned, frozen, or fresh)										21
Tomatoes										22
Peppers (green, red, hot)										23
Carrots										24
Broccoli										25
Green beans										26
Spinach										27
Greens (mustard, turnip, collards)										28
Squash, orange or winter										29
French fries, fried potatoes										30
Potatoes (baked, boiled, or mashed)										31
Sweet potatoes or yams										32
Cabbage or coleslaw										33
Lettuce salad										34
Salad dressing or mayonnaise										35

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Chips (potato, corn, others)										36
Nuts										37
Cookies or brownies										38
Cake or cupcake										39
Pie (pumpkin, sweet potato, or squash)										40
Other pie										41
Jello										42
Chocolate candy										43
Other candy										44
Tea										45
Soft drinks										46
Sugar-free soft drinks										47

Scale 75% of original

Mark only one X for each food

How often did your child eat a serving of these foods during the past 4 weeks?

	last 4 weeks		each week			each day				
Number of times	0	1-3	1	2-4	5-6	1	2-3	4-5	6 +	
Baked beans or chili beans										48
Other dried beans, peas, or Lima beans										49
Rice										50
Spaghetti or other pasta with sauce										51
Pizza										52
Macaroni and cheese										53
Hot dogs										54
Hamburgers, meatballs, or meatloaf										55
Canned tuna										56
Cold cuts (baloney, ham, salami)										57
Peanut butter										58
Bread, toast, or rolls										59
Margarine or butter										60
Chicken or turkey										61
Pork chops, roast pork, or ribs										62
Steak or roast beef										63
Fish										64
Liver										65
Sausage										66
Bacon										67
Hot cereal or grits										68
Cold breakfast cereal										69
Donut										70
Sweet roll or muffin										71
Pancake, waffle, or French toast										72
English muffin or bagel										73
Biscuit										74
Cornbread or tortillas										75
Vegetable soup										76
Other soup										77
Crackers										78

How many eggs does your child eat in one week? ____________________

Scale 75% of original

Cuestionario de Nutrición de Niños

Nombre ____________
ID ____________
Fecha ____________
Fecha de Nacimiento ____________
EDAD ____________
Respondedor
Madre [ ]
Otro [ ] ____________

¿Qué ha estado comiendo su niño últimamente?

¿Durante las últimas 4 semanas, qué tan a menudo comió su niño una porción de cada alimento en la lista que sigue?
Marque solamente una X por cada comida

	últimas 4 semanas		cada semana			cada día				
Numero de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
Leche										1
Chocolate caliente										2
Queso, sólo o en sandwich										3
Yogurt										4
Helado, nreve										5
Budín, pudín										6

¿Qué clase de leche bebe su niño?
[ ] leche entera
[ ] leche parcialmente descremada (lowfat)
[ ] leche descremada o desnatad (nonfat)

	últimas 4 semanas		cada semana			cada día				
Numero de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
China (naranja)										7
Jugo de china (naranja)										8
Jugo de manzana										9
Otros jugos de frutas (Hi-C, Kool-aid, lemonada)										10
Guineo, plátano o banano										11
Manzana o puré de manzana										12
Uvas										13
Melocotón, durazno										14
Fresas										15
Melón										16
Sandía, melón de agua										17
Piña										18
Pasas										19

Scale 75% of original

Marque solamente una X por cada comida

¿Qué tan a menudo comió su niño una porción de ellos alimentos en las últimas 4 semanas?

	últimas 4 semanas		cada semana			cada día				
Número de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
Maíz, elote										20
Guisante, chícharo (enlatado, congelado o fresco)										21
Tomates										22
Pimientos (verde, rojo o picante)										23
Zanahoria										24
Broccoli o brecol										25
Habichuelas verde, ejote										26
Espinaca										27
Verduras (nabo o acelga)										28
Calabaza										29
Papas fritas										30
Papas (asada o hervida o en puré)										31
Batata o ñame, camote										32
Repollo o ensalada de col										33
Ensalada de lechuga										34
Aderezo para ensalada o mayonesa										35

	últimas 4 semanas		cada semana			cada día				
Número de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
Papitas fritas, doraditas, chips de maíz o otras										36
Nueces										37
Galletas										38
Bizcocho, bizcochito redondo, pastel										39
Pastel, pie o empanada (calabaza o camote)										40
Otro pastel, pie o empanada										41
Jaleas, mermeladas										42
Dulce de chocolate										43
Otros dulces										44
Té										45
Refrescos										46
Refrescos sin azúcar										47

Scale 75% of original

Marque solamente una X por cada comida

¿Qué tan a menudo comió su niño una porción de ellos alimentos en las últimas 4 semanas?

	últimas 4 semanas		cada semana			cada dia				
Número de veces	0	1-3	1	2-4	5-6	1	2-4	4-5	6 +	
Habichuelas asadas con chile, frijoles guisados										48
Otras habichuelas, frijoles secos, guisante, chícaro o haba										49
Arroz										50
Espaguetti u otra pasta con salsa										51
Pizza										52
Macarrones con queso										53
Hot dog										54
Hamburguesa, albóndiga o carne mechada, deshebrada										55
Atún de lata										56
Fiambres (bologna, jamón, salami), carnes frías										57
Mantequilla de maní, cacahuate										58
Pan, tostado o bolillos										59
Margarina o mantequilla										60
Pollo o pavo										61
Chuletas, carne de res o costillas										62
Bistec o rosbif										63
Pescado										64
Hígado										65
Salchichas										66
Tocino										67
Cereal caliente, avena o atole										68
Cereal frío para el desayuno										69
Donas										70
Pan dulce										71
Panque, hot cakes o French toast										72
English muffin o bagel										73
Bizcocho, bisquetes										74
Pan de maiz o tortilla										75
Sopa de verdura, caldo de verdura										76
Otras sopas, caldos										77
Galletas saladas										78

¿Cuantos huevos come su niño en una semana? ____________________

Scale 75% of original

APPENDIX C

FIELD DATA COLLECTION FORMS

Intake Form

PLEASE PRINT ___ ___ ___ ___ ___ ___ ___

Your Name:____
first middle last

Mailing Address:____

City, Zip:____

1. **Do you have any children ages 1 to 4 years old?** ☐ Yes ☐ No

If Yes, please list the name, birth date & age of each child:

Name	Birth Date	Age
______________	____/____/____ month day year	____ years
______________	____/____/____ month day year	____ years
______________	____/____/____ month day year	____ years
______________	____/____/____ month day year	____ years

2. **Do you have any children less than 1 year old?** ☐ Yes ☐ No

If Yes, please list the name, birth date & age of each child:

Name	Birth Date	Age
______________	____/____/____ month day year	____ months
______________	____/____/____ month day year	____ months

Are you breast-feeding your child? ☐ Yes ☐ No

During the next month, do you plan to breast-feed your child?
☐ Yes ☐ No ☐ Not Sure

3. **Are you pregnant?** ☐ Yes ☐ No ☐ Not Sure

If Yes, when is your due date? ____/____ month day

continue on other side ➡

Scale 75% of original

4. Are you:
☐African-American ☐Hispanic/Latina ☐White ☐Other:__________________
(specify)

5. Your birth date: ____/____/____ (month day year) Your age: ________years

Your height: ________ft. ________in. Your weight: ________lbs.

6. Do you smoke? ☐ Yes ☐ No

7. Have you been on WIC anytime during the past 4 weeks? ☐ Yes ☐ No

Please do not write below

1☐ Eligible child (1-4 years only) ☐ Eligible, not selected
2☐ Pregnant ☐ Not eligible: (explain)
3☐ Postpartum, breast-feeding (0-12 months only) ____________
4☐ Postpartum, not breast-feeding (0-6 months only) ____________

Telephone: (____) ____________ Location: ____________

Days/times: ____________

Telephone: (____) ____________ Location: ____________

Days/times: ____________

Other contact: ____________ (contact name) (____) ____________ (phone)

Child selected for study: ____________ (child's name)

Child's Sex: ☐M ☐F Birthday: ____/____/____ (month day year) Age: ________ (years)

Knowledge of child's diet? ☐Yes ☐No Child on WIC last 4 wks? ☐Yes ☐No

Participant on Special Diet: ☐None ☐Weight loss ☐Diabetic ☐Other:____________ (specify)

Appointment: ____/____/____ (date) ____________ (time)

Notes: ____________

Selected:

____/____/____ (today's date) ____/ (FFQ) ____/ (ETH) ____/ (CAT) ____/ (SITE) ____ ____ (PART #) ____

Intake Form - WIC Dietary Assessment Validation Study, USDA Contract #53-3198-2-032, Freeman, Sullivan & Co. (7/93)

Scale 75% of original

Consent Form

AGREEMENT

The purpose of this study is to test some food survey forms to see how well these measure what kinds of foods people eat. The results of this study will help improve services to women and children at WIC clinics throughout the U.S.

Your participation in this study is voluntary. If you choose to participate, all information you provide will be confidential. Your participation will not affect your WIC status, eligibility or benefits for you or your child.

To participate:

- You must have a working telephone where you live.
- You must be available during the next 6 weeks.
- You must meet other qualifications for the study as explained.
- You must complete an initial food survey today telling us about what you (or your child) usually eats. This will take about 20 minutes to complete.
- You must agree to complete 3 interviews by telephone about what you (or your child) ate during an entire day. Each interview will last about 30 minutes.
- You must agree to return to the WIC clinic to complete a second food survey in about 1 month. When you have completed this last step, you will be mailed a $30 money order within 10 days to cover your expenses for helping with this study.

If you have any questions about this study or your participation, please call the WIC Project Assistant at 1-800-777-0737 (toll free).

Your appointment to complete the second survey:

Date ______________________ Time ______________

I have read and understand the above information and have discussed this information with the project's staff person. I agree to participate voluntarily in this study.

______________________ ______________
Participant's Signature Date

______________________ ______________
Project Staff Date

ID# __ __ __/ __ __ __ __

Consent Form - WIC Dietary Assessment Validation Study, USDA Contract #53-3198-2-032, Freeman, Sullivan & Co. (7/93)

Scale 75% of original

Exit Form

PLEASE PRINT ID# _ _ _ _ _ _ _

Name:____
first middle last

Child's Name:____
(if applicable) first middle last

Mailing Address:______________________________________

City, Zip:____

Telephone: (____)_____________________ Location: ______________

Study Category:	**Telephone Recalls Completed:**
1☐ Eligible child (1-4 years only)	☐ 3
2☐ Pregnant	☐ 2
3☐ Postpartum, breast-feeding (0-12 months only)	☐ 1
4☐ Postpartum, not breast-feeding (0-6 months only)	☐ None

Total years of school completed: (circle one)

1 2 3 4 5 6 7 8	9 10 11 12	13 14 15 16	17+	________ mos.
(elementary)	(secondary)	(college)	(graduate)	(vocational school)

If in Pregnant category, still pregnant? ☐ Yes ☐ No ☐ N/A

If in Postpartum category:

Breast-feeding her child? ☐ Yes ☐ No ☐ N/A

During the past month, breast-fed her child? ☐ Yes ☐ No ☐ N/A

Participant on WIC anytime during the past 4 weeks? ☐ Yes ☐ No

OK to contact again by phone if we have questions about the food surveys or the recall interviews? ☐ Yes ☐ No

Any complaints, problems, suggestions:

Notes:

_____/_____/_____ Project Staff:
today's date

Exit Form - WIC Dietary Assessment Validation Study, USDA Contract #53-3198-2-032, Freeman, Sullivan & Co. (9/93)

Scale 75% of original

APPENDIX D

APPENDIX TABLES

Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates with No FFQs Dropped *

Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates with Outlier FFQs Dropped *

***** ***Interpreting p-values in Tables D-4 to D-27:***

A p-value of < 0.05 indicates that the FFQ significantly under- or over-estimates mean nutrient intake when compared to the recall data.

Table D-1
Adjusted Validity Coefficients for Harvard and Block FFQ-1

		All Cases Included		Outliers Dropped	
		Harvard	Block	Harvard	Block
African American	Energy	0.22	0.63	0.15	0.44
	Protein	0.26	0.52	0.09	0.40
	Vitamin A	0.00	0.34	0.01	0.16
	Vitamin C	-0.44	0.39	-0.28	0.35
	Iron	0.02	0.47	0.03	0.23
	Calcium	0.32	0.51	0.46	0.44
Hispanic	Energy	0.22	0.15	0.09	0.08
	Protein	0.15	0.10	0.12	0.00
	Vitamin A	0.51	0.19	0.50	0.31
	Vitamin C	0.32	0.21	0.20	0.18
	Iron	0.33	-0.01	-0.03	-0.14
	Calcium	0.20	0.17	0.15	0.20
White	Energy	0.31	0.49	0.33	0.53
	Protein	0.38	0.59	0.43	0.62
	Vitamin A	0.35	0.74	0.37	0.66
	Vitamin C	0.39	0.24	0.37	0.16
	Iron	0.32	0.55	0.37	0.46
	Calcium	0.44	0.63	0.48	0.57
All Women	Energy	0.22	0.42	0.18	0.34
	Protein	0.28	0.39	0.25	0.31
	Vitamin A	0.25	0.39	0.22	0.31
	Vitamin C	0.15	0.36	0.15	0.29
	Iron	0.23	0.30	0.13	0.14
	Calcium	0.33	0.47	0.39	0.40
Pregnant	Energy	0.25	0.33	0.24	0.24
	Protein	0.34	0.36	0.28	0.31
	Vitamin A	0.36	0.31	0.36	0.23
	Vitamin C	0.15	0.22	0.10	0.14
	Iron	0.38	0.05	0.36	-0.08
	Calcium	0.46	0.41	0.53	0.31
Breastfeeding	Energy	0.26	0.29	0.14	0.22
	Protein	0.21	0.27	0.15	0.12
	Vitamin A	0.30	0.34	0.31	0.36
	Vitamin C	0.06	0.26	0.03	0.15
	Iron	0.07	0.33	-0.31	0.22
	Calcium	0.20	0.36	0.28	0.32
Non-breastfeeding	Energy	0.16	0.53	0.16	0.50
	Protein	0.22	0.50	0.19	0.41
	Vitamin A	0.10	0.47	0.00	0.36
	Vitamin C	0.21	0.47	0.24	0.49
	Iron	0.24	0.43	0.24	0.26
	Calcium	0.26	0.50	0.21	0.43
Children	Energy	0.15	0.16	0.26	0.11
	Protein	0.23	0.18	0.37	0.04
	Vitamin A	0.36	0.04	0.38	0.08
	Vitamin C	0.12	0.23	0.23	0.36
	Iron	0.01	0.19	0.06	0.24
	Calcium	0.30	0.04	0.26	0.04

Table D-2
Adjusted Validity Coefficients for Harvard and Block FFQ-2

		All Cases Included		Outliers Dropped	
		Harvard	Block	Harvard	Block
African American	Energy	0.38	0.49	0.55	0.53
	Protein	0.24	0.49	0.39	0.52
	Vitamin A	0.21	0.20	0.35	0.09
	Vitamin C	0.13	0.44	0.18	0.44
	Iron	0.18	0.50	0.33	0.54
	Calcium	0.42	0.52	0.68	0.60
Hispanic	Energy	0.18	0.15	0.14	0.07
	Protein	0.17	0.13	0.16	0.10
	Vitamin A	0.42	0.09	0.38	0.03
	Vitamin C	0.39	0.31	0.35	0.40
	Iron	0.42	0.05	0.13	0.08
	Calcium	0.21	0.34	0.18	0.21
White	Energy	0.41	0.47	0.46	0.45
	Protein	0.37	0.53	0.41	0.52
	Vitamin A	0.33	0.73	0.39	0.62
	Vitamin C	0.51	0.42	0.59	0.29
	Iron	0.29	0.60	0.31	0.59
	Calcium	0.50	0.57	0.60	0.48
All Women	Energy	0.27	0.35	0.37	0.35
	Protein	0.25	0.37	0.34	0.38
	Vitamin A	0.29	0.28	0.32	0.20
	Vitamin C	0.38	0.43	0.38	0.42
	Iron	0.29	0.34	0.25	0.38
	Calcium	0.37	0.50	0.54	0.46
Pregnant	Energy	0.22	0.26	0.51	0.38
	Protein	0.26	0.35	0.45	0.47
	Vitamin A	0.20	0.29	0.30	0.41
	Vitamin C	0.40	0.22	0.39	0.33
	Iron	0.21	0.21	0.34	0.42
	Calcium	0.25	0.39	0.48	0.41
Breastfeeding	Energy	0.35	0.34	0.39	0.38
	Protein	0.24	0.27	0.37	0.33
	Vitamin A	0.34	0.32	0.31	0.21
	Vitamin C	0.33	0.48	0.43	0.45
	Iron	0.33	0.45	0.08	0.51
	Calcium	0.39	0.39	0.56	0.32
Non-breastfeeding	Energy	0.16	0.37	0.19	0.27
	Protein	0.19	0.44	0.13	0.36
	Vitamin A	0.22	0.20	0.23	-0.06
	Vitamin C	0.30	0.50	0.19	0.44
	Iron	0.27	0.31	0.22	0.17
	Calcium	0.39	0.56	0.40	0.52
Children	Energy	0.17	0.38	0.32	0.35
	Protein	0.26	0.31	0.42	0.17
	Vitamin A	0.37	0.10	0.27	0.11
	Vitamin C	0.22	0.27	0.24	0.40
	Iron	0.10	0.32	0.20	0.47
	Calcium	0.32	0.23	0.31	0.23

Table D-3
Validity Coefficients Averaging FFQ-1 and FFQ-2

		All Cases Included		Outliers Dropped	
		Harvard	Block	Harvard	Block
African American	Energy	0.27	0.51	0.26	0.50
	Protein	0.21	0.49	0.18	0.46
	Vitamin A	0.05	0.23	0.14	0.14
	Vitamin C	-0.13	0.37	-0.04	0.42
	Iron	0.05	0.45	0.14	0.44
	Calcium	0.34	0.51	0.44	0.52
Hispanic	Energy	0.18	0.13	0.18	0.20
	Protein	0.14	0.10	0.16	0.18
	Vitamin A	0.39	0.12	0.41	0.14
	Vitamin C	0.34	0.24	0.29	0.32
	Iron	0.33	-0.01	0.09	0.09
	Calcium	0.18	0.22	0.19	0.29
White	Energy	0.34	0.43	0.34	0.45
	Protein	0.38	0.51	0.38	0.54
	Vitamin A	0.37	0.65	0.37	0.65
	Vitamin C	0.47	0.29	0.44	0.29
	Iron	0.33	0.50	0.30	0.54
	Calcium	0.55	0.56	0.55	0.56
All Women	Energy	0.23	0.37	0.26	0.39
	Protein	0.24	0.36	0.26	0.39
	Vitamin A	0.22	0.29	0.25	0.29
	Vitamin C	0.27	0.36	0.28	0.40
	Iron	0.23	0.29	0.18	0.32
	Calcium	0.32	0.46	0.43	0.47
Pregnant	Energy	0.23	0.28	0.31	0.39
	Protein	0.27	0.35	0.33	0.43
	Vitamin A	0.26	0.25	0.33	0.31
	Vitamin C	0.28	0.20	0.25	0.28
	Iron	0.27	0.11	0.30	0.24
	Calcium	0.35	0.40	0.47	0.44
Breastfeeding	Energy	0.30	0.29	0.24	0.30
	Protein	0.21	0.24	0.23	0.25
	Vitamin A	0.24	0.26	0.23	0.17
	Vitamin C	0.23	0.34	0.24	0.38
	Iron	0.17	0.34	-0.13	0.38
	Calcium	0.32	0.35	0.39	0.32
Non-breastfeeding	Energy	0.14	0.45	0.15	0.42
	Protein	0.17	0.44	0.16	0.42
	Vitamin A	0.11	0.30	0.05	0.27
	Vitamin C	0.17	0.42	0.16	0.43
	Iron	0.22	0.34	0.23	0.32
	Calcium	0.27	0.49	0.27	0.52
Children	Energy	0.14	0.24	0.27	0.27
	Protein	0.21	0.22	0.32	0.23
	Vitamin A	0.29	0.07	0.26	0.07
	Vitamin C	0.16	0.23	0.22	0.34
	Iron	0.04	0.21	0.10	0.22
	Calcium	0.32	0.14	0.35	0.10

Table D-4
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
No FFQs dropped

Energy (kcal)

		Harvard		Block	
		Recalls	FFQ-1	Recalls	FFQ-1
All Women	*median*	**1,897**	**2,167**	**1,905**	**1,823**
	mean	1,994	2,685	1,994	2,034
	SD	607	2,040	635	1,262
	n	235	235	234	234
	p	<0.01		0.62	
African American	*median*	**2,164**	**2,246**	**2,147**	**1,998**
	mean	2,211	2,747	2,176	2,137
	SD	671	1,900	670	1,276
	n	81	81	82	82
	p	<0.05		0.75	
Hispanic	*median*	**1,780**	**2,554**	**1,848**	**1,786**
	mean	1,810	3,220	1,909	2,161
	SD	482	2,538	570	1,550
	n	71	71	84	84
	p	<0.01		0.15	
White	*median*	**1,865**	**1,931**	**1,740**	**1,689**
	mean	1,941	2,169	1,878	1,752
	SD	579	1,528	628	690
	n	83	83	68	68
	p	0.18		0.13	
Pregnant	*median*	**1,965**	**2,022**	**2,046**	**1,867**
	mean	2,115	2,528	2,122	1,997
	SD	592	1,716	631	836
	n	75	75	81	81
	p	<0.05		0.21	
Breastfeeding	*median*	**1,983**	**2,211**	**1,917**	**1,929**
	mean	2,056	2,865	2,013	2,066
	SD	583	2,340	606	888
	n	81	81	74	74
	p	<0.01		0.63	
Non-breastfeeding	*median*	**1,634**	**2,155**	**1,698**	**1,606**
	mean	1,816	2,651	1,844	2,042
	SD	611	2,005	642	1,816
	n	79	79	79	79
	p	<0.01		0.29	
Children	*median*	**1,179**	**1,730**	**1,350**	**1,323**
	mean	1,259	2,043	1,344	1,449
	SD	397	1,630	374	695
	n	94	94	87	87
	p	<0.01		0.20	

Table D-5
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
No FFQs dropped

Protein (g)

		Harvard		Block	
		Recalls	FFQ-1	Recalls	FFQ-1
All Women	*median*	**78.4**	**76.8**	**76.8**	**79.1**
	mean	79.6	97.0	79.6	90.2
	SD	25.5	77.3	27.5	61.8
	n	235	235	234	234
	p	<0.01		<0.01	
African American	*median*	**85.4**	**79.1**	**84.4**	**79.9**
	mean	86.0	101.6	83.2	94.9
	SD	27.0	74.7	27.9	59.0
	n	81	81	82	82
	p	0.06		0.05	
Hispanic	*median*	**76.2**	**88.8**	**74.4**	**74.3**
	mean	76.3	116.6	79.6	94.9
	SD	21.7	99.8	27.2	80.0
	n	71	71	84	84
	p	<0.01		0.09	
White	*median*	**71.9**	**66.9**	**72.1**	**79.5**
	mean	76.0	75.8	75.3	78.8
	SD	26.0	48.0	27.0	31.0
	n	83	83	68	68
	p	0.97		0.31	
Pregnant	*median*	**80.3**	**76.0**	**86.0**	**87.1**
	mean	82.8	93.4	86.3	86.7
	SD	27.2	69.7	28.4	38.4
	n	75	75	81	81
	p	0.18		0.93	
Breastfeeding	*median*	**81.6**	**83.6**	**73.4**	**84.3**
	mean	83.1	104.1	79.3	93.0
	SD	23.7	89.5	25.9	39.0
	n	81	81	74	74
	p	<0.05		<0.01	
Non-breastfeeding	*median*	**69.3**	**73.1**	**70.6**	**70.3**
	mean	72.9	93.2	73.1	91.3
	SD	24.5	70.9	26.7	91.9
	n	79	79	79	79
	p	<0.05		0.07	
Children	*median*	**47.4**	**60.5**	**50.8**	**59.2**
	mean	47.5	71.7	52.0	67.0
	SD	13.9	48.6	14.5	34.4
	n	94	94	87	87
	p	<0.01		<0.01	

Table D-6
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
No FFQs dropped

Vitamin A (RE)

		Harvard		Block	
		Recalls	FFQ-1	Recalls	FFQ-1
All Women	*median*	**763**	**1,597**	**779**	**1,232**
	mean	882	2,504	896	1,544
	SD	499	5,134	505	2,253
	n	235	235	234	234
	p	<0.01		<0.01	
African American	*median*	**703**	**1,514**	**803**	**1,236**
	mean	835	2,118	887	1,539
	SD	473	2,224	526	2,063
	n	81	81	82	82
	p	<0.01		<0.01	
Hispanic	*median*	**791**	**2,559**	**691**	**1,229**
	mean	895	4,262	867	1,811
	SD	540	8,763	506	3,099
	n	71	71	84	84
	p	<0.01		<0.01	
White	*median*	**814**	**1,279**	**827**	**1,174**
	mean	918	1,378	943	1,219
	SD	490	855	482	646
	n	83	83	68	68
	p	<0.01		<0.01	
Pregnant	*median*	**814**	**1,507**	**814**	**1,236**
	mean	945	2,054	971	1,321
	SD	516	2,033	543	713
	n	75	75	81	81
	p	<0.01		<0.01	
Breastfeeding	*median*	**843**	**1,756**	**819**	**1,559**
	mean	947	3,271	936	1,630
	SD	490	8,074	489	814
	n	81	81	74	74
	p	<0.05		<0.01	
Non-breastfeeding	*median*	**629**	**1,576**	**709**	**867**
	mean	756	2,146	781	1,691
	SD	475	2,713	465	3,734
	n	79	79	79	79
	p	<0.01		<0.05	
Children	*median*	**561**	**897**	**557**	**818**
	mean	636	1,239	600	996
	SD	302	1,021	266	585
	n	94	94	87	87
	p	<0.01		<0.01	

Table D-7
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
No FFQs dropped

Vitamin C (mg)

		Harvard		Block	
		Recalls	FFQ-1	Recalls	FFQ-1
All Women	*median*	**114**	**145**	**97**	**109**
	mean	125	199	117	130
	SD	78	168	69	101
	n	235	235	234	234
	p	<0.01		0.07	
African American	*median*	**142**	**148**	**86**	**104**
	mean	145	199	109	125
	SD	78	161	68	110
	n	81	81	82	82
	p	<0.05		0.22	
Hispanic	*median*	**121**	**209**	**132**	**130**
	mean	137	252	141	159
	SD	85	184	69	112
	n	71	71	84	84
	p	<0.01		0.20	
White	*median*	**77**	**111**	**76**	**88**
	mean	97	154	97	100
	SD	65	149	62	60
	n	83	83	68	68
	p	<0.01		0.73	
Pregnant	*median*	**122**	**164**	**110**	**116**
	mean	134	202	127	129
	SD	77	155	71	78
	n	75	75	81	81
	p	<0.01		0.86	
Breastfeeding	*median*	**131**	**157**	**116**	**110**
	mean	137	219	126	137
	SD	80	191	69	83
	n	81	81	74	74
	p	<0.01		0.36	
Non-breastfeeding	*median*	**82**	**133**	**77**	**89**
	mean	105	176	98	125
	SD	75	154	64	133
	n	79	79	79	79
	p	<0.01		0.08	
Children	*median*	**62**	**99**	**77**	**79**
	mean	76	137	81	94
	SD	44	121	40	62
	n	94	94	87	87
	p	<0.01		0.09	

Table D-8
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
No FFQs dropped

Iron (mg)

		Harvard Recalls	Harvard FFQ-1	Block Recalls	Block FFQ-1
All Women	*median*	**14.2**	**10.8**	**13.6**	**10.8**
	mean	14.5	14.5	14.3	11.6
	SD	5.2	12.0	5.5	8.3
	n	235	235	234	234
	p	0.99		<0.01	
African American	*median*	**15.2**	**11.2**	**13.9**	**11.1**
	mean	15.5	14.4	15.0	11.9
	SD	5.2	10.7	5.9	8.1
	n	81	81	82	82
	p	0.38		<0.01	
Hispanic	*median*	**13.2**	**14.3**	**13.5**	**11.4**
	mean	14.3	19.3	13.9	13.4
	SD	5.1	15.6	5.4	10.6
	n	71	71	84	84
	p	<0.01		0.72	
White	*median*	**12.7**	**9.4**	**13.1**	**9.3**
	mean	13.5	10.4	13.9	9.2
	SD	5.0	7.3	5.2	3.6
	n	83	83	68	68
	p	<0.01		<0.01	
Pregnant	*median*	**14.2**	**10.7**	**14.4**	**11.2**
	mean	15.6	13.7	15.1	11.1
	SD	5.6	10.5	5.6	4.6
	n	75	75	81	81
	p	0.12		<0.01	
Breastfeeding	*median*	**14.5**	**11.8**	**14.1**	**11.2**
	mean	14.5	15.5	15.0	12.0
	SD	4.3	14.3	5.7	4.9
	n	81	81	74	74
	p	0.50		<0.01	
Non-breastfeeding	*median*	**12.3**	**10.8**	**11.3**	**9.8**
	mean	13.3	14.1	12.8	11.9
	SD	5.3	10.8	5.1	12.7
	n	79	79	79	79
	p	0.54		0.53	
Children	*median*	**9.7**	**9.3**	**9.6**	**6.4**
	mean	10.2	11.2	10.3	8.0
	SD	3.4	8.7	3.7	4.5
	n	94	94	87	87
	p	0.27		<0.01	

Table D-9
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
No FFQs dropped

Calcium (mg)

		Harvard		Block	
		Recalls	FFQ-1	Recalls	FFQ-1
All Women	*median*	**842**	**1,172**	**834**	**1,031**
	mean	876	1,319	893	1,289
	SD	382	888	400	908
	n	235	235	234	234
	p	<0.01		<0.01	
African American	*median*	**758**	**1,187**	**717**	**945**
	mean	800	1,316	799	1,263
	SD	365	803	376	889
	n	81	81	82	82
	p	<0.01		<0.01	
Hispanic	*median*	**874**	**1,292**	**835**	**983**
	mean	892	1,464	891	1,300
	SD	339	999	355	1,051
	n	71	71	84	84
	p	<0.01		<0.01	
White	*median*	**852**	**1,047**	**1,010**	**1,243**
	mean	935	1,197	1,009	1,307
	SD	424	857	452	735
	n	83	83	68	68
	p	<0.01		<0.01	
Pregnant	*median*	**886**	**1,199**	**1,023**	**1,265**
	mean	953	1,289	1,030	1,353
	SD	418	756	439	798
	n	75	75	81	81
	p	<0.01		<0.01	
Breastfeeding	*median*	**897**	**1,292**	**865**	**1,174**
	mean	942	1,488	915	1,427
	SD	365	954	353	794
	n	81	81	74	74
	p	<0.01		<0.01	
Non-breastfeeding	*median*	**713**	**908**	**656**	**851**
	mean	734	1,173	733	1,093
	SD	326	915	342	1,075
	n	79	79	79	79
	p	<0.01		<0.01	
Children	*median*	**627**	**858**	**715**	**1,021**
	mean	682	1,011	756	1,082
	SD	263	638	272	614
	n	94	94	87	87
	p	<0.01		<0.01	

Table D-10
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
Outlier FFQs Dropped

Energy (kcal)

		Harvard		Block	
		Recalls	FFQ-1	Recalls	FFQ-1
All Women	*median*	**1,839**	**1,985**	**1,957**	**1,893**
	mean	1,961	2,058	2,012	2,014
	SD	593	919	636	806
	n	*204*	*204*	*208*	*208*
	p	0.17		0.97	
African American	*median*	**2,105**	**2,109**	**2,219**	**2,074**
	mean	2,160	2,172	2,213	2,155
	SD	653	999	631	860
	n	70	70	71	71
	p	0.92		0.58	
Hispanic	*median*	**1,662**	**2,184**	**1,848**	**1,786**
	mean	1,752	2,243	1,910	1,984
	SD	436	913	575	866
	n	57	57	78	78
	p	<0.01		0.51	
White	*median*	**1,815**	**1,728**	**1,763**	**1,812**
	mean	1,935	1,817	1,904	1,884
	SD	585	798	668	625
	n	77	77	59	59
	p	0.23		0.82	
Pregnant	*median*	**1,949**	**1,967**	**2,103**	**1,929**
	mean	2,094	2,015	2,159	2,102
	SD	594	950	624	791
	n	66	66	74	74
	p	0.53		0.58	
Breastfeeding	*median*	**1,897**	**2,166**	**1,925**	**1,929**
	mean	1,984	2,152	2,002	1,975
	SD	525	902	603	684
	n	70	70	69	69
	p	0.16		0.79	
Non-breastfeeding	*median*	**1,594**	**1,885**	**1,711**	**1,727**
	mean	1,808	2,002	1,854	1,956
	SD	630	911	652	938
	n	68	68	65	65
	p	0.13		0.37	
Children	*median*	**1,219**	**1,574**	**1,396**	**1,323**
	mean	1,267	1,600	1,359	1,417
	SD	409	585	378	546
	n	82	82	81	81
	p	<0.01		0.42	

Table D-11
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
Outlier FFQs Dropped

Protein (g)

		Harvard		Block	
		Recalls	FFQ-1	Recalls	FFQ-1
All Women	*median*	**76.2**	**72.4**	**78.0**	**81.1**
	mean	78.5	74.3	80.4	89.0
	SD	25.3	34.0	27.5	37.5
	n	*204*	*204*	*208*	*208*
	p	0.13		<0.01	
African American	*median*	**81.5**	**75.1**	**84.4**	**86.7**
	mean	83.8	80.1	84.5	95.9
	SD	26.5	40.1	27.1	42.0
	n	70	70	71	71
	p	0.51		<0.05	
Hispanic	*median*	**74.5**	**77.9**	**74.4**	**74.3**
	mean	74.9	78.9	79.4	85.9
	SD	21.4	28.1	27.2	39.1
	n	57	57	78	78
	p	0.37		0.23	
White	*median*	**76.2**	**63.6**	**73.6**	**87.8**
	mean	76.3	65.6	76.8	84.7
	SD	26.4	30.4	28.3	27.9
	n	77	77	59	59
	p	<0.01		<0.05	
Pregnant	*median*	**75.9**	**72.6**	**88.9**	**91.2**
	mean	81.8	72.6	88.1	91.3
	SD	27.2	35.1	28.5	36.8
	n	66	66	74	74
	p	0.06		0.49	
Breastfeeding	*median*	**80.3**	**75.7**	**74.2**	**83.9**
	mean	81.3	79.9	78.3	89.5
	SD	22.7	33.9	25.2	32.1
	n	70	70	69	69
	p	0.76		<0.05	
Non-breastfeeding	*median*	**68.6**	**67.7**	**71.4**	**71.8**
	mean	72.3	70.1	73.8	85.8
	SD	25.2	32.7	27.0	43.6
	n	68	68	65	65
	p	0.66		<0.05	
Children	*median*	**48.2**	**56.4**	**52.0**	**59.2**
	mean	47.8	58.1	52.5	65.5
	SD	14.5	22.7	14.5	26.7
	n	82	82	81	81
	p	<0.01		<0.01	

Table D-12
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
Outlier FFQs Dropped

Vitamin A (RE)

		Harvard Recalls	Harvard FFQ-1	Block Recalls	Block FFQ-1
All Women	*median*	**763**	**1,435**	**803**	**1,270**
	mean	877	1,672	909	1,421
	SD	496	1,119	496	794
	n	*204*	*204*	*208*	*208*
	p	<0.01		<0.01	
African American	*median*	**754**	**1,395**	**798**	**1,340**
	mean	865	1,668	872	1,423
	SD	494	1,158	482	771
	n	70	70	71	71
	p	<0.01		<0.01	
Hispanic	*median*	**746**	**2,090**	**700**	**1,229**
	mean	824	2,246	883	1,484
	SD	509	1,256	518	933
	n	57	57	78	78
	p	<0.01		<0.01	
White	*median*	**814**	**1,227**	**882**	**1,292**
	mean	928	1,251	990	1,335
	SD	491	730	484	603
	n	77	77	59	59
	p	<0.01		<0.01	
Pregnant	*median*	**781**	**1,303**	**862**	**1,324**
	mean	939	1,619	1,007	1,396
	SD	514	1,159	549	698
	n	66	66	74	74
	p	<0.01		<0.01	
Breastfeeding	*median*	**807**	**1,623**	**782**	**1,552**
	mean	922	1,801	932	1,607
	SD	483	1,035	489	765
	n	70	70	69	69
	p	<0.01		<0.01	
Non-breastfeeding	*median*	**652**	**1,332**	**709**	**925**
	mean	771	1,591	775	1,252
	SD	482	1,165	413	891
	n	68	68	65	65
	p	<0.01		<0.01	
Children	*median*	**537**	**805**	**557**	**818**
	mean	618	970	596	955
	SD	300	591	266	500
	n	82	82	81	81
	p	<0.01		<0.01	

Table D-13
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
Outlier FFQs Dropped

Vitamin C (mg)

		Harvard		Block	
		Recalls	FFQ-1	Recalls	FFQ-1
All Women	*median*	**113**	**124**	**104**	**111**
	mean	125	164	120	128
	SD	79	121	70	78
	n	*204*	*204*	*208*	*208*
	p	<0.01		0.24	
African American	*median*	**148**	**132**	**88**	**109**
	mean	153	168	115	124
	SD	79	119	71	81
	n	70	70	71	71
	p	0.42		0.42	
Hispanic	*median*	**101**	**187**	**133**	**130**
	mean	128	206	141	148
	SD	84	132	69	85
	n	57	57	78	78
	p	<0.01		0.59	
White	*median*	**73**	**104**	**83**	**99**
	mean	96	130	100	107
	SD	65	103	64	57
	n	77	77	59	59
	p	<0.01		0.49	
Pregnant	*median*	**121**	**137**	**116**	**124**
	mean	130	171	131	136
	SD	72	119	72	77
	n	66	66	74	74
	p	<0.05		0.70	
Breastfeeding	*median*	**122**	**127**	**117**	**110**
	mean	137	178	125	131
	SD	83	134	68	73
	n	70	70	69	69
	p	<0.05		0.60	
Non-breastfeeding	*median*	**80**	**120**	**85**	**92**
	mean	106	143	103	116
	SD	78	106	68	83
	n	68	68	65	65
	p	<0.05		0.24	
Children	*median*	**63**	**81**	**76**	**78**
	mean	77	109	81	88
	SD	45	76	40	52
	n	82	82	81	81
	p	<0.01		0.29	

Table D-14
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
Outlier FFQs Dropped

Iron (mg)

		Harvard Recalls	Harvard FFQ-1	Block Recalls	Block FFQ-1
All Women	*median*	**13.5**	**10.2**	**24.0**	**11.1**
	mean	14.2	10.9	14.5	11.5
	SD	5.1	5.2	5.5	4.3
	n	*204*	*204*	*208*	*208*
	p	<0.01		<0.01	
African American	*median*	**15.4**	**10.8**	**14.0**	**11.3**
	mean	15.6	11.3	15.2	11.9
	SD	5.4	5.5	5.6	4.8
	n	70	70	71	71
	p	<0.01		<0.01	
Hispanic	*median*	**12.4**	**12.7**	**13.8**	**11.4**
	mean	13.3	13.2	14.0	12.3
	SD	4.7	5.1	5.6	4.5
	n	57	57	78	78
	p	0.92		<0.05	
White	*median*	**13.7**	**8.9**	**14.1**	**10.3**
	mean	13.6	8.8	14.4	10.0
	SD	5.0	4.0	5.3	3.1
	n	77	77	59	59
	p	<0.01		<0.01	
Pregnant	*median*	**14.0**	**10.2**	**14.5**	**11.3**
	mean	15.4	10.5	15.3	11.7
	SD	5.8	5.5	5.6	4.3
	n	66	66	74	74
	p	<0.01		<0.01	
Breastfeeding	*median*	**14.3**	**10.8**	**14.1**	**11.1**
	mean	14.0	11.3	15.0	11.5
	SD	4.3	5.0	5.5	3.7
	n	70	70	69	69
	p	<0.01		<0.01	
Non-breastfeeding	*median*	**12.3**	**9.9**	**12.1**	**10.5**
	mean	13.3	10.8	13.1	11.2
	SD	5.0	5.1	5.1	5.2
	n	68	68	65	65
	p	<0.01		<0.05	
Children	*median*	**10.0**	**8.5**	**9.8**	**6.4**
	mean	10.2	8.7	10.3	7.8
	SD	3.5	3.3	3.6	3.7
	n	82	82	81	81
	p	<0.01		<0.01	

Table D-15
Nutrient Comparisons of Diet Recalls and FFQ-1 Estimates
Outlier FFQs Dropped

Calcium (mg)

		Harvard		Block	
		Recalls	FFQ-1	Recalls	FFQ-1
All Women	*median*	**823**	**1,061**	**847**	**1,053**
	mean	864	1,082	910	1,292
	SD	379	556	397	792
	n	*204*	*204*	*208*	*208*
	p	<0.01		<0.01	
African American	*median*	**762**	**1,069**	**735**	**1,000**
	mean	796	1,110	823	1,305
	SD	375	548	362	806
	n	70	70	71	71
	p	<0.01		<0.01	
Hispanic	*median*	**869**	**1,150**	**856**	**962**
	mean	860	1,115	899	1,195
	SD	300	502	359	842
	n	57	57	78	78
	p	<0.01		<0.01	
White	*median*	**847**	**983**	**1,023**	**1,289**
	mean	928	1,031	1,029	1,403
	SD	426	602	457	700
	n	77	77	59	59
	p	0.12		<0.01	
Pregnant	*median*	**890**	**1,103**	**1,040**	**1,411**
	mean	943	1,115	1,074	1,427
	SD	397	581	427	785
	n	66	66	74	74
	p	<0.05		<0.01	
Breastfeeding	*median*	**870**	**1,214**	**856**	**1,098**
	mean	929	1,218	901	1,390
	SD	373	492	345	767
	n	70	70	69	69
	p	<0.01		<0.01	
Non-breastfeeding	*median*	**683**	**738**	**650**	**898**
	mean	719	909	733	1,034
	SD	328	556	336	777
	n	68	68	65	65
	p	<0.05		<0.01	
Children	*median*	**622**	**809**	**704**	**1,074**
	mean	668	852	747	1,066
	SD	255	381	275	507
	n	82	82	81	81
	p	<0.01		<0.01	

Table D-16
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
No FFQs Dropped

Energy (kcal)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**1,897**	**1,834**	**1,905**	**1,518**
	mean	1,994	2,255	1,994	1,730
	SD	607	1,898	635	1,047
	n	235	235	234	234
	p	<0.05		<0.01	
African American	*median*	**2,164**	**1,956**	**2,147**	**1,503**
	mean	2,211	2,320	2,176	1,764
	SD	671	1,821	670	1,069
	n	81	81	82	82
	p	0.58		<0.01	
Hispanic	*median*	**1,780**	**2,094**	**1,848**	**1,595**
	mean	1,810	2,848	1,909	1,822
	SD	482	2,579	570	1,260
	n	71	71	84	84
	p	<0.01		0.56	
White	*median*	**1,865**	**1,596**	**1,740**	**1,474**
	mean	1,941	1,685	1,878	1,576
	SD	579	852	628	657
	n	83	83	68	68
	p	<0.01		<0.01	
Pregnant	*median*	**1,965**	**1,978**	**2,046**	**1,612**
	mean	2,115	2,360	2,122	1,758
	SD	592	1,712	631	882
	n	75	75	81	81
	p	0.24		<0.01	
Breastfeeding	*median*	**1,983**	**1,886**	**1,917**	**1,691**
	mean	2,056	2,455	2,013	1,867
	SD	583	2,291	606	1,003
	n	81	81	74	74
	p	0.11		0.22	
Non-breastfeeding	*median*	**1,634**	**1,565**	**1,698**	**1,255**
	mean	1,816	1,950	1,844	1,574
	SD	611	1,578	642	1,222
	n	79	79	79	79
	p	0.47		0.06	
Children	*median*	**1,179**	**1,437**	**1,350**	**1,166**
	mean	1,259	1,704	1,344	1,304
	SD	397	1,105	374	559
	n	94	94	87	87
	p	<0.01		0.52	

Table D-17
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
No FFQs Dropped

Protein (g)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**78.4**	**65.6**	**76.8**	**69.1**
	mean	79.6	81.3	79.6	77.5
	SD	25.5	71.6	27.5	51.7
	n	235	235	234	234
	p	0.71		0.54	
African American	*median*	**85.4**	**65.6**	**84.4**	**74.4**
	mean	86.0	85.6	83.1	81.0
	SD	27.0	77.7	27.9	50.3
	n	81	81	82	82
	p	0.96		0.68	
Hispanic	*median*	**76.2**	**74.4**	**74.4**	**67.7**
	mean	76.3	100.9	79.6	80.1
	SD	21.7	91.1	27.2	64.5
	n	71	71	84	84
	p	<0.05		0.95	
White	*median*	**71.9**	**57.1**	**72.1**	**67.8**
	mean	76.0	60.4	75.3	70.0
	SD	26.0	29.5	27.0	31.6
	n	83	83	68	68
	p	<0.01		0.15	
Pregnant	*median*	**80.3**	**67.4**	**86.0**	**70.6**
	mean	82.8	82.3	86.3	76.8
	SD	27.1	54.5	28.4	42.2
	n	75	75	81	81
	p	0.95		0.06	
Breastfeeding	*median*	**81.6**	**69.5**	**73.4**	**73.2**
	mean	83.1	91.1	79.3	84.6
	SD	23.7	91.6	25.9	45.0
	n	81	81	74	74
	p	0.43		0.33	
Non-breastfeeding	*median*	**69.3**	**56.2**	**70.6**	**57.4**
	mean	72.9	70.3	73.1	71.4
	SD	24.5	61.1	26.7	64.6
	n	79	79	79	79
	p	0.72		0.82	
Children	*median*	**47.4**	**51.8**	**50.8**	**55.2**
	mean	47.5	62.0	52.0	59.4
	SD	13.9	38.2	14.5	27.0
	n	94	94	87	87
	p	<0.01		<0.05	

Table D-18
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
No FFQs Dropped

Vitamin A (RE)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**763**	**1,251**	**779**	**978**
	mean	882	2,111	896	1,405
	SD	499	3,670	505	1,657
	n	235	235	234	234
	p	<0.01		<0.01	
African American	*median*	**703**	**1,211**	**803**	**1,046**
	mean	835	1,715	887	1,364
	SD	473	1,865	526	1,329
	n	81	81	82	82
	p	<0.01		<0.01	
Hispanic	*median*	**791**	**1,945**	**691**	**911**
	mean	895	3,715	867	1,606
	SD	540	6,023	506	2,305
	n	71	71	84	84
	p	<0.01		<0.01	
White	*median*	**814**	**1,033**	**827**	**972**
	mean	918	1,126	943	1,207
	SD	490	846	482	860
	n	83	83	68	68
	p	0.05		<0.01	
Pregnant	*median*	**814**	**1,404**	**814**	**934**
	mean	945	1,934	971	1,408
	SD	516	1,853	543	1,557
	n	75	75	81	81
	p	<0.01		<0.05	
Breastfeeding	*median*	**843**	**1,438**	**819**	**1,349**
	mean	947	2,581	936	1,506
	SD	490	5,001	489	992
	n	81	81	74	74
	p	<0.01		<0.01	
Non-breastfeeding	*median*	**629**	**870**	**709**	**802**
	mean	756	1,797	781	1,308
	SD	475	3,339	465	2,185
	n	79	79	79	79
	p	<0.01		<0.05	
Children	*median*	**561**	**813**	**557**	**815**
	mean	636	1,097	600	887
	SD	302	921	266	440
	n	94	94	87	87
	p	<0.01		<0.01	

Table D-19
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
No FFQs Dropped

Vitamin C (mg)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**114**	**105**	**97**	**90**
	mean	125	151	117	107
	SD	78	135	69	80
	n	235	235	234	234
	p	<0.01		0.09	
African American	*median*	**142**	**116**	**86**	**89**
	mean	145	158	109	99
	SD	78	124	68	62
	n	81	81	82	82
	p	0.42		0.27	
Hispanic	*median*	**121**	**135**	**132**	**100**
	mean	137	199	141	131
	SD	85	177	69	104
	n	71	71	84	84
	p	<0.01		0.41	
White	*median*	**77**	**83**	**76**	**84**
	mean	97	103	97	87
	SD	65	78	62	52
	n	83	83	68	68
	p	0.49		0.26	
Pregnant	*median*	**122**	**142**	**110**	**98**
	mean	134	185	127	105
	SD	77	140	71	57
	n	75	75	81	81
	p	<0.01		<0.05	
Breastfeeding	*median*	**131**	**127**	**116**	**97**
	mean	137	158	126	116
	SD	80	127	69	73
	n	81	81	74	74
	p	0.15		0.30	
Non-breastfeeding	*median*	**82**	**79**	**77**	**76**
	mean	105	111	98	100
	SD	75	129	64	102
	n	79	79	79	79
	p	0.71		0.87	
Children	*median*	**62**	**73**	**77**	**70**
	mean	76	109	81	84
	SD	44	93	40	51
	n	94	94	87	87
	p	<0.01		0.63	

Table D-20
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
No FFQs Dropped

Iron (mg)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**14.2**	**9.6**	**13.6**	**8.9**
	mean	14.5	12.5	14.3	10.1
	SD	5.2	12.1	5.5	7.1
	n	235	235	234	234
	p	<0.05		<0.01	
African American	*median*	**15.2**	**9.9**	**13.9**	**9.2**
	mean	15.5	12.2	15.0	10.1
	SD	5.2	9.5	5.9	6.1
	n	81	81	82	82
	p	<0.01		<0.01	
Hispanic	*median*	**13.2**	**12.5**	**13.5**	**9.6**
	mean	14.3	17.6	13.9	11.5
	SD	5.1	17.7	5.4	9.6
	n	71	71	84	84
	p	0.10		0.06	
White	*median*	**12.7**	**7.6**	**13.1**	**8.0**
	mean	13.5	8.3	13.9	8.5
	SD	5.0	4.7	5.2	3.5
	n	83	83	68	68
	p	<0.01		<0.01	
Pregnant	*median*	**14.2**	**10.6**	**14.4**	**9.3**
	mean	15.6	12.7	15.1	10.2
	SD	5.6	9.5	5.6	5.4
	n	75	75	81	81
	p	<0.05		<0.01	
Breastfeeding	*median*	**14.5**	**10.1**	**14.1**	**9.9**
	mean	14.5	14.2	15.0	11.0
	SD	4.3	15.8	5.7	5.8
	n	81	81	74	74
	p	0.87		<0.01	
Non-breastfeeding	*median*	**12.3**	**7.8**	**11.3**	**7.6**
	mean	13.3	10.5	12.8	9.3
	SD	5.3	9.6	5.1	9.5
	n	79	79	79	79
	p	<0.05		<0.01	
Children	*median*	**9.7**	**8.3**	**9.6**	**6.1**
	mean	10.2	9.4	10.3	6.9
	SD	3.4	6.3	3.7	3.3
	n	94	94	87	87
	p	0.32		<0.01	

Table D-21
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
No FFQs Dropped

Calcium (mg)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**842**	**989**	**834**	**905**
	mean	876	1,098	893	1,100
	SD	382	755	400	788
	n	235	235	234	234
	p	<0.01		<0.01	
African American	*median*	**758**	**899**	**717**	**819**
	mean	800	1,028	799	1,042
	SD	365	688	376	836
	n	81	81	82	82
	p	<0.01		<0.01	
Hispanic	*median*	**874**	**1,236**	**835**	**905**
	mean	892	1,341	891	1,097
	SD	339	938	355	782
	n	71	71	84	84
	p	<0.01		<0.05	
White	*median*	**852**	**966**	**1,010**	**1,037**
	mean	935	960	1,009	1,173
	SD	424	581	452	742
	n	83	83	68	68
	p	0.70		0.05	
Pregnant	*median*	**886**	**1,149**	**1,023**	**949**
	mean	953	1,240	1,030	1,144
	SD	418	736	439	683
	n	75	75	81	81
	p	<0.01		0.14	
Breastfeeding	*median*	**897**	**1,042**	**865**	**1,049**
	mean	942	1,180	915	1,242
	SD	365	785	353	793
	n	81	81	74	74
	p	<0.01		<0.01	
Non-breastfeeding	*median*	**713**	**749**	**656**	**726**
	mean	734	880	733	922
	SD	326	699	342	859
	n	79	79	79	79
	p	0.07		<0.05	
Children	*median*	**627**	**816**	**715**	**955**
	mean	682	910	756	1,032
	SD	263	510	272	570
	n	94	94	87	87
	p	<0.01		<0.01	

Table D-22
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
Outlier FFQs Dropped

Energy (kcal)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*medien*	**1,871**	**1,706**	**1,998**	**1,643**
	meen	1,988	1,789	2,040	1,793
	SD	601	793	650	803
	n	215	215	197	197
	p	<0.01		<0.01	
African American	*medien*	**2,164**	**1,758**	**2,279**	**1,699**
	meen	2,213	1,839	2,249	1,923
	SD	665	886	685	974
	n	73	73	66	66
	p	<0.01		<0.01	
Hispanic	*medien*	**1,695**	**1,998**	**1,861**	**1,607**
	meen	1,777	1,944	1,938	1,732
	SD	441	771	567	762
	n	60	60	74	74
	p	0.13		0.06	
White	*medien*	**1,868**	**1,589**	**1,824**	**1,705**
	mean	1,942	1,630	1,932	1,721
	SD	582	698	662	607
	n	82	82	57	57
	p	<0.01		<0.05	
Pregnant	*medien*	**2,091**	**1,904**	**2,087**	**1,700**
	meen	2,135	1,940	2,155	1,833
	SD	601	743	646	631
	n	69	69	66	66
	p	<0.05		<0.01	
Breastfeeding	*medien*	**1,922**	**1,791**	**2,056**	**1,699**
	mean	2,023	1,848	2,047	1,860
	SD	554	744	604	903
	n	73	73	70	70
	p	<0.05		0.09	
Non-breastfeeding	*medien*	**1,634**	**1,458**	**1,721**	**1,436**
	meen	1,814	1,587	1,909	1,672
	SD	612	853	691	846
	n	73	73	61	61
	p	<0.05		0.07	
Children	*median*	**1,229**	**1,346**	**1,402**	**1,182**
	mean	1,276	1,503	1,361	1,301
	SD	404	596	385	421
	n	88	88	77	77
	p	<0.01		0.28	

Table D-23
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
Outlier FFQs Dropped

Protein (g)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**76.9**	**63.1**	**78.6**	**71.4**
	mean	79.4	64.9	81.7	79.3
	SD	25.7	29.3	28.2	36.9
	n	215	215	197	197
	p	<0.01		0.40	
African American	*median*	**85.6**	**64.0**	**86.7**	**78.2**
	mean	86.2	67.0	86.3	88.2
	SD	27.5	33.9	28.9	45.1
	n	73	73	66	66
	p	<0.01		0.72	
Hispanic	*median*	**75.0**	**70.8**	**74.7**	**69.1**
	mean	75.3	70.8	80.5	73.6
	SD	21.0	27.9	27.3	32.6
	n	60	60	74	74
	p	0.30		0.16	
White	*median*	**72.3**	**57.1**	**73.9**	**71.8**
	mean	76.2	58.6	77.8	76.4
	SD	26.1	24.8	28.5	29.6
	n	82	82	57	57
	p	<0.01		0.73	
Pregnant	*median*	**81.3**	**66.0**	**89.4**	**74.2**
	mean	83.5	68.8	88.6	79.0
	SD	27.6	28.2	29.4	29.4
	n	69	69	66	66
	p	<0.01		<0.05	
Breastfeeding	*median*	**80.5**	**66.7**	**78.2**	**74.2**
	mean	82.5	69.0	80.4	83.8
	SD	23.7	28.5	26.1	37.7
	n	73	73	70	70
	p	<0.01		0.46	
Non-breastfeeding	*median*	**69.1**	**55.5**	**73.1**	**65.1**
	mean	72.4	57.0	75.5	74.4
	SD	24.4	29.9	28.2	42.7
	n	73	73	61	61
	p	<0.01		0.84	
Children	*median*	**48.4**	**51.2**	**50.8**	**56.2**
	mean	48.1	55.2	52.4	58.7
	SD	14.2	23.2	14.8	18.6
	n	88	88	77	77
	p	<0.01		<0.05	

Table D-24
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
Outlier FFQs Dropped

Vitamin A (RE)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**763**	**1,143**	**811**	**1,063**
	mean	877	1,440	927	1,409
	SD	499	1,170	498	1,140
	n	215	215	197	197
	p	<0.01		<0.01	
African American	*median*	**703**	**1,089**	**844**	**1,145**
	mean	853	1,329	940	1,528
	SD	490	918	514	1,404
	n	73	73	66	66
	p	<0.01		<0.01	
Hispanic	*median*	**746**	**1,695**	**691**	**959**
	mean	843	2,076	860	1,351
	SD	525	1,629	493	1,068
	n	60	60	74	74
	p	<0.01		<0.01	
White	*median*	**829**	**1,032**	**873**	**1,106**
	mean	923	1,072	1,000	1,348
	SD	490	697	483	864
	n	82	82	57	57
	p	0.10		<0.01	
Pregnant	*median*	**814**	**1,330**	**888**	**1,045**
	mean	959	1,588	1,007	1,419
	SD	530	1,157	544	1,199
	n	69	69	66	66
	p	<0.01		<0.01	
Breastfeeding	*median*	**814**	**1,369**	**819**	**1,389**
	mean	922	1,689	930	1,531
	SD	475	1,376	465	970
	n	73	73	70	70
	p	<0.01		<0.01	
Non-breastfeeding	*median*	**630**	**845**	**755**	**915**
	mean	755	1,050	837	1,259
	SD	475	820	476	1,250
	n	73	73	61	61
	p	<0.01		<0.05	
Children	*median*	**544**	**782**	**546**	**835**
	mean	623	939	588	867
	SD	302	585	265	356
	n	88	88	77	77
	p	<0.01		<0.01	

Table D-25
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
Outlier FFQs Dropped

Vitamin C (mg)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**107**	**99**	**104**	**97**
	mean	124	125	122	110
	SD	79	97	70	66
	n	215	215	197	197
	p	0.79		0.05	
African American	*median*	**141**	**104**	**89**	**96**
	mean	146	138	112	107
	SD	80	110	69	58
	n	73	73	66	66
	p	0.59		0.57	
Hispanic	*median*	**111**	**111**	**138**	**101**
	mean	132	148	145	126
	SD	86	108	71	78
	n	60	60	74	74
	p	0.28		0.06	
White	*median*	**78**	**83**	**88**	**89**
	mean	98	98	102	95
	SD	65	66	64	53
	n	82	82	57	57
	p	0.92		0.45	
Pregnant	*median*	**121**	**124**	**113**	**101**
	mean	130	161	129	109
	SD	75	113	72	49
	n	69	69	66	66
	p	<0.05		<0.05	
Breastfeeding	*median*	**128**	**118**	**119**	**99**
	mean	137	134	129	117
	SD	82	92	69	68
	n	73	73	70	70
	p	0.80		0.21	
Non-breastfeeding	*median*	**79**	**73**	**88**	**88**
	mean	104	83	105	105
	SD	77	65	67	79
	n	73	73	61	61
	p	0.08		0.95	
Children	*median*	**62**	**70**	**76**	**69**
	mean	76	96	82	83
	SD	45	70	41	47
	n	88	88	77	77
	p	<0.05		0.98	

Table D-26
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
Outlier FFQs Dropped

Iron (mg)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**13.9**	**9.0**	**14.1**	**9.7**
	mean	14.3	9.7	14.7	10.4
	SD	5.1	4.8	5.6	4.5
	n	215	215	197	197
	p	<0.01		<0.01	
African American	*median*	**15.5**	**9.4**	**14.2**	**10.4**
	mean	15.7	9.7	15.6	11.1
	SD	5.3	4.8	5.8	5.4
	n	73	73	66	66
	p	<0.01		<0.01	
Hispanic	*median*	**12.9**	**11.4**	**14.1**	**9.8**
	mean	13.5	11.8	14.2	10.5
	SD	4.7	5.2	5.4	4.3
	n	60	60	74	74
	p	0.06		<0.01	
White	*median*	**13.2**	**7.5**	**14.1**	**9.0**
	mean	13.5	8.0	14.4	9.3
	SD	5.0	3.7	5.4	3.1
	n	82	82	57	57
	p	<0.01		<0.01	
Pregnant	*median*	**14.2**	**10.2**	**14.5**	**9.9**
	mean	15.7	10.4	15.4	10.5
	SD	5.7	4.5	5.6	3.4
	n	69	69	66	66
	p	<0.01		<0.01	
Breastfeeding	*median*	**14.3**	**9.3**	**14.5**	**10.0**
	mean	14.0	10.3	15.3	10.9
	SD	4.2	5.0	5.6	4.9
	n	73	73	70	70
	p	<0.01		<0.01	
Non-breastfeeding	*median*	**12.3**	**7.7**	**12.7**	**8.6**
	mean	13.2	8.3	13.3	9.7
	SD	5.0	4.6	5.2	4.9
	n	73	73	61	61
	p	<0.01		<0.01	
Children	*median*	**9.7**	**7.7**	**9.6**	**6.2**
	mean	10.2	8.3	10.3	7.0
	SD	3.4	3.4	3.6	2.6
	n	88	88	77	77
	p	<0.01		<0.01	

Table D-27
Nutrient Comparisons of Diet Recalls and FFQ-2 Estimates
Outlier FFQs Dropped

Calcium (mg)

		Harvard		Block	
		Recalls	FFQ-2	Recalls	FFQ-2
All Women	*median*	**844**	**933**	**873**	**948**
	mean	877	939	918	1,155
	SD	379	485	400	764
	n	215	215	197	197
	p	<0.05		<0.01	
African American	*median*	**784**	**800**	**776**	**868**
	mean	817	887	827	1,119
	SD	374	510	375	837
	n	73	73	66	66
	p	0.17		<0.01	
Hispanic	*median*	**865**	**1,110**	**835**	**916**
	mean	865	1,020	908	1,091
	SD	304	432	360	719
	n	60	60	74	74
	p	<0.05		<0.05	
White	*median*	**857**	**962**	**1,030**	**1.178**
	mean	940	926	1,038	1,282
	SD	424	498	451	729
	n	82	82	57	57
	p	0.78		<0.05	
Pregnant	*median*	**895**	**1,144**	**1,034**	**1,039**
	mean	967	1,097	1,069	1,216
	SD	398	495	436	631
	n	69	69	66	66
	p	<0.05		0.07	
Breastfeeding	*median*	**896**	**958**	**881**	**1,102**
	mean	940	1,005	930	1,250
	SD	372	466	353	775
	n	73	73	70	70
	p	0.21		<0.01	
Non-breastfeeding	*median*	**713**	**706**	**656**	**789**
	mean	729	724	742	980
	SD	322	421	343	859
	n	73	73	61	61
	p	0.92		<0.05	
Children	*median*	**623**	**789**	**691**	**951**
	mean	674	846	738	1,007
	SD	264	378	274	468
	n	88	88	77	77
	p	<0.01		<0.01	

APPENDIX E

MISCELLANEOUS APPENDICES

APPENDIX E-1

DEVELOPMENT OF MODIFIED BLOCK FFQ

The Block FFQ used in this study are modifications of the Block/NCI Health Habits and History Questionnaire (Block et al., 1986). This appendix describes the development of the children's FFQ, the specific ways in which the FFQ food list used here differs from earlier versions, the development of the FFQ manual scoring system, and instructions for scoring the Block FFQ.

Development of Block FFQ Food List and Portion Sizes for Children

<u>Food List</u>

The food list used for women in the present study was determined after examination of 1) NHANES II data on nutrient sources among young female Whites and African Americans, and among low-income persons (Block, unpublished data); and 2) Hispanic HANES (HHANES) data on nutrient sources among low-income Hispanic women (Block et al., 1994). Modifications to the resulting food list for children were minimal, and were based on nutrient sources lists in HHANES for low-income children, ages 1-4. These modifications chiefly involved omitting alcoholic beverages; adding "Baby food fruit"; changing the wording of "cooked cereals, grits" to "cooked cereals, grits, hot baby food cereals"; dropping the reference to coffee/tea and moving sugar to the cereal section. Thus, the food list for children was essentially identical to that for adults. In Section 5, a suggestion is made for further analyses in the existing data set, to explore whether a substantially reduced food list might improve correlations.

Nutrient Content

Nutrient contents of the foods on the list were not changed from those on the adult database. Nutrients for "baby food fruit" were based upon comparable items in Revised Handbook 8.

Portion Sizes

Portion sizes for all foods on the children's food list were derived from an examination of the HHANES portion sizes for low-income children in this age group. This survey, based on a national sample, used three-dimensional models to assist the respondents in estimating portion size, and were thought to provide good data on actual amounts consumed by children. The portion sizes used for adults on the Block database had been developed in an exactly analogous way, among the adults in NHANES II.

The individual food codes on the HHANES database were re-coded to group them into similar items corresponding to the foods on the FFQ. For example, 11 HANES codes for green beans were re-coded into a single item, "green beans". The gram portion size responses for all HHANES responses from all low-income respondents, aged 1-4, were then arrayed. Thus, for each of the 62 items on the child's FFQ, actual reported gram portion sizes were arrayed, and a small, medium and large amount identified. This was done separately for children 1-2 and 3-4 as well as combined. It was found that for some foods, it was necessary to have two different portion size sets for the two age groups, although this was not necessary for all foods. "Medium" was identified as the median amount consumed in that age group, or a large mode close to that median. "Small" and "large" were identified as large modes above and below the medium.

Description of Modifications to Block FFQ for this Study

As described in Section 3.3, wording and items of the Block FFQ were modified somewhat for this study. The food list was essentially a modification of the Block 60-item FFQ, described in (Block, G., 1990) and used in the 1987 and 1992 National Health Interview Surveys. The modifications were undertaken to simplify the wording of some of the items, necessary because of the probable literacy level of the study population and the fact that it was

to be self-administered rather than administered by interview as the NHIS surveys were. In addition, some items were omitted as being relatively unimportant in this population. Some items were combined, particularly because assessment of the different types of fat was not a goal of WIC. Some items were separated into two items, to better capture some foods important in the WIC or in the Hispanic population. And some items were added, for the same reason.

The following list shows differences between the 1992 NHIS version of the Block FFQ and the version used for this study. Other versions of the "60-item version" of the Block FFQ contain slightly different wordings or items.

Items Unchanged

Bananas

Oranges

Green salad

Broccoli

Sweet potatoes, yams

Any other vegetable

Rice

Eggs

Pizza

Biscuits, muffins

Liver including chicken liver

Pork, pork chops, roasts

Fried chicken

Hot dogs

Peanuts, peanut butter

Items Added

Apple juice, grape juice

Cooked green peppers, chile rellenos

Milk on cereal

Tuna sandwich or tuna casserole

Any other soup -- [i.e., other than vegetable]

Salsa, taco sauce, ketchup, hot red peppers

Flour tortillas

Yogurt, frozen yogurt (including lowfat)

Items Omitted

Grapefruit

High fiber cereals like bran, granola, or shredded wheat

Highly fortified cereals like Product 19, Total, or Just Right

Dark breads like whole wheat, rye or pumpernickel

Pie

Chicken stew or chicken pot pie

Fish broiled or baked

Items Combined

"Greens, spinach"

instead of two items, "Spinach" and "Mustard greens, turnip greens or collards"

"Potatoes, including French fries"

instead of two items, "French fries or fried potatoes" and "Potatoes, baked, boiled or mashed"

"Bacon, sausage, links"

instead of two items, "Bacon" and "Sausage"

"Margarine or butter"

instead of two items, "Butter on bread, rolls or vegetables" and "Margarine on bread, rolls or vegetables"

"Lowfat and skim milk (not including milk on cereal)"

instead of two items, "2% milk or drinks made with 2% milk, not including on cereal" and "Skim milk, 1% milk or buttermilk, not including on cereal"

Separated Into Two Items

"Chili with meat or beans (American style)" and "Beans like pinto or refried beans"

instead of "Beans, such as baked, pinto, kidney beans, or in chili"

"Corn tortillas" and "Corn bread, corn muffins"

instead of "Corn bread, corn muffins, corn tortillas, or grits"

"Cake, cookies" and "Donuts, pastry"

instead of "Doughnuts, cookies, cake or pastry"

Items Reworded

"Peaches, cantaloupe"

instead of "Cantaloupe in season"

"Apples, grapes or any other fruit"

instead of "Apples or applesauce"

"Orange juice"

instead of "Orange juice or grapefruit juice"

"Kool-Aid, fruit drinks, Hi-C"

instead of "Other fruit juices or fortified fruit drinks"

"Carrots"

instead of "Carrots, or mixed vegetables containing carrots"

"Tomatoes"

instead of "Tomatoes, including in salad"

"Salad dressing"

instead of "Salad dressing or mayonnaise, including on sandwiches"

"Any other vegetable"

instead of "Any other vegetable, such as string beans, peas, corn"

"Cole slaw, cabbage"

instead of "Coleslaw, cabbage or sauerkraut"

"Cooked cereals, grits"

instead of "Cooked cereals like oatmeal"

"Cold cereals, such as Cheerios, with or without milk"

instead of "Other cold cereals like Rice Krispies or corn flakes"

"Spaghetti with tomato sauce"

instead of "Spaghetti, lasagna or pasta with tomato sauce"

"Mixed dishes with cheese, macaroni and cheese"

instead of "Macaroni and cheese, other mixed dishes with cheese"

"Hamburgers, cheeseburgers, beef burritos, tacos"

instead of "Hamburgers, cheeseburgers or meatballs"

"Beef (steak or roast), ribs"

instead of "Beef, such as steaks or roasts"

"Mixed dishes with beef like beef stew"

instead of "Beef stew or potpie with vegetables"

"Other chicken (stewed, baked or roasted"

instead of "Chicken or turkey, baked, stewed or broiled"

"Fish, fish sandwich"

instead of "Fried fish or fish sandwich"

"Vegetable soup, tomato soup"

instead of "Vegetable soup, vegetable beef, minestrone or tomato soup"

"Lunch meats, sliced ham"

instead of "Ham or lunch meats"

"Cheese and cheese spread"

instead of "Cheese or cheese spreads, not including cottage cheese"

"Bread, including sandwiches, bagels and burger rolls"

instead of "White bread, rolls or crackers, including sandwiches, bagels and so forth"

"Chips, popcorn, crackers, pork skins"

instead of "Salty snacks like chips or popcorn"

"Ice cream or pudding"

instead of "Ice cream not including fat free ice cream"

"Chocolate candy, candy bars"

instead of "Chocolate candy"

"Milk or cream in coffee or tea"

instead of "Milk or cream in coffee or tea including nondairy creamer"

"Regular milk (not including milk on cereal"

instead of "Whole milk or drinks made with whole milk, not including on cereal"

"Regular soft drinks (not diet soda)"

instead of "Non-diet soda or soft drinks"

"Beer, all types"

instead of "... beer"

"All types of wine, wine coolers"

instead of "... wine"

"Liquor (all types)

instead of "... liquor"

"Sugar in coffee, tea or on cereal (not sugar substitutes)

instead of "Sugar in coffee or tea or on cereal"

Development of Block Manual Scores

The Block manual scores were designed to identify persons with high or low intake of five nutrients of interest to WIC: calcium, iron, protein, vitamin A and vitamin C. Previous work has shown (Byers et al., 1985; Block et al., 1989) that very short lists of foods can rank persons reasonably well provided that they are selected correctly. To this end, the most important contributors of those nutrients were identified for African Americans and whites in the NHANES II data (Block et al., 1985a, 1985b) and for Hispanics in the Hispanic HANES data (Block et al., 1994). The top 10-19 foods were selected, the indicator foods, representing approximately 70% of the intake of those nutrients in these national data sets.

To simplify scoring, the frequency categories on the FFQ (3-4/week, 2+/day, etc.) were each assigned a value from zero to 4 (0 to 6 for beverages). See the small numbers at the bottom of each column of the Block FFQ, Appendix A.

Consumption of foods less than once per week	0 points
Consumption of foods 1-2 times per week	1 point
Consumption of foods 3-6 times per week	2 points
Consumption of foods 1 time per day	3 points
Consumption of foods 2+ times per day	4 points

For beverages the frequency categories on the FFQ permit more frequent consumption. Therefore, the scoring was slightly different for beverages:

Consumption of foods less than twice per week	0 points
Consumption of foods 2-4 times per week	1 point
Consumption of foods 5-6 times per week	2 points
Consumption of foods 1 time per day	3 points
Consumption of foods 2 times per day	4 points
Consumption of foods 3-4 times per day	5 points
Consumption of foods 5-6 times per day	6 points

Only the indicator foods are given a score. This produces a one-digit interim score for each nutrient on each page, added at the end of the booklet for the total nutrient score. The result is a continuous variable, with total scores ranging from zero to 76 points. If a "pass/fail" criterion is needed, this variable can be used with any cutpoint along its range, to achieve the "proportion eligible" affordable by funding constraints. As shown in Section 4.2, scoring took a median of three minutes.

For the present study, arbitrary cutpoints had to be selected a priori in order to permit "pass/fail" comparisons with the Harvard manual score (which provides only pass/fail scores). To achieve this, an attempt was made to determine cutpoints that would

correspond to the RDA. First, the nutrient estimates from the Block full FFQ were calculated, and then their distribution adjusted to correspond approximately to the distribution of nutrient intakes seen among women (or children) in this age-income category in CSFII 1986. The CART procedure (Classification and Regression Trees) was then used to identify that manual score cutpoint that best classified the sample with respect to the RDA of the adjusted FFQ nutrient estimate. The same procedure was used to identify a cutpoint corresponding to 1.5x RDA of the adjusted FFQ nutrient estimate. That is, manual score cutpoints were developed by reference to the adjusted FFQ distribution, and not by reference to the 24-hour recall distribution. The recalls were used only to test the success of the cutpoints that had been devised as just described.

The cutpoints used in the present analysis are shown in the following.

Cutpoints for Adults

Nutrients	Low	Adequate	Ample
Vitamin C	7 or less	8	9 or more
Vitamin A	12 or less	13	14 or more
Protein	9 or less	10-13	14 or more
Iron	16 or less	17-24	25 or more
Calcium	15 or less	16-18	19 or more

("Low" = Less than RDA; "Ample" = > 1.5x RDA. Exception: for Calcium in adults, "Low" = < 800 mg, "Ample" = > 1200 mg.)

Cutpoints for Children, Age 1-4

Nutrients	Low	Adequate	Ample
Vitamin C	8 or less	9-12	13 or more
Vitamin A	14 or less	15-20	21 or more
Protein	5 or less	6-7	8 or more
Iron	18 or less	19-22	23 or more
Calcium	16 or less	17-20	21 or more

("Low" = Less than RDA; "Ample" = > 1.5x RDA. Exception: for Calcium in adults, "Low" = < 800 mg, "Ample" = > 1200 mg.)

However, as can been seen in Table 4-25, these cutpoints did not always correspond well to the nutrient distribution seen in the 24-hour recalls in the present study. The following cutpoints may approximate better the RDA levels among African American and White women seen in this study:

Cutpoints for Adults

Nutrients	Low
Vitamin C	9 or less
Vitamin A	16 or less
Protein	10 or less
Iron	20 or less
Calcium	17 or less

Instructions for Manual Scoring of Modified Block FFQ

In this study, the following instructions were provided to field aides for scoring the Block FFQs manually.

Scoring the Block FFQ

- At the bottom of each column a person has marked, there is a corresponding scoring number.
- Look at the scoring number for each column and write this number in all of the shaded boxes on the right-hand side of the page.
- If there are no shaded boxes for a particular food, do not write anything.
- Do this for all of the pages. Note on page 4, there are different sets of scoring numbers for both grids.
- Next add the numbers in each column of the shaded boxes on each page. Write the total for each column in the shaded box at the bottom for Vitamin C, Vitamin A, Protein, Iron and Calcium.
- Transfer the totals for each page to the summary boxes on page 5.
- Add the columns in the summary boxes to get an FFQ total score for Vitamin C, Vitamin A, Protein, Iron and Calcium.

APPENDIX E-2

PROBLEMS ENCOUNTERED IN THE USE OF THE HARVARD FFQ

Reliability of the WICENTER Program

A number of tests were conducted to determine the reliability of the Harvard WICENTER software in generating consistent nutrient calculations. It was found that the women's program, ENTERW, calculated nutrient values from the food item scores in a consistent manner. The children's program, ENTERC, when subjected to the same tests, was found to be unreliable. In a variety of situations, tests of the ENTERC program generated age 3 through 4 values for children ages 1 through 2 and vice versa. These tests are described below.

In "Test 1," a number of Harvard FFQ records were pulled from the study representing ages 1.00 through 5.04 years. First, the data were entered using solely the ENTERC program. Miscalculations occurred in records with ages 3.01 and 3.92. In the second step, each record was opened to edit mode using the ENTERC program and closed. This produced correct and consistent calculations for all records.

Significant problems also occurred when attempts were made to alter a participant's age on an existing record using the ENTERC program. For example, when the same Test 1 record was re-opened and the birth date modified so that the calculated age would be 4.00 to 4.92 years, miscalculations occurred in records with initial ages 1.00, 1.01, 1.49, 1.96, 2.00, 2.04, and 2.50 years When the birth date was again modified to an age between 1.00 and 2.50 years, errors occurred in 12 out of 13 records with initial ages 1.00 to 4.52 years When these records were re-opened and closed again with no modification, the correct lower age calculations occurred.

In "Test 2," fictitious test records were entered using ENTERC with all food item scores equal to "2." These records were entered multiple times with different birth dates and calculated ages Upon initial entry, one miscalculation occurred at age 4.00. When

the same records were simply opened and closed, another miscalculation occurred at age 2.99.

In "Test 3," a fictitious test record was entered with all food item scores equal to "1." The record was entered multiple times with different birth dates and calculated ages. Upon initial entry, no miscalculations occurred. However, when the records were simply opened and closed, an error occurred at age 2.99. When the test was repeated with all food item scores equal to "2," the same miscalculation occurred at age 2.99 when the record was re-opened and closed.

In summary, it was observed that the WICENTER children's program, ENTERC, will sometimes generate false values both upon initial entry and during the recalculation of an existing record. The results seem to be particularly inaccurate if the child's age in an existing record is modified. A similar problem was observed in the WICENTER RDA display module. This on-line function sometimes would display different RDA values for the same set of food item scores.

For the purposes of this validation study, a number of steps were taken to insure the accuracy of the Harvard FFQ nutrient calculations for children. Two identical files of unprocessed records were created. In the first file, the session date and birth date were set so that all the children would have a calculated age of 1.1 years. In the second file, dates were set so that the children would all have a calculated age of 4.9 years. Both files were then processed using the ENTERC program. Each record was opened to edit mode and closed, causing the program to calculate the nutrient values.

In this manner, two files with calculated nutrient values, one with all records containing values for ages 1 through 2 (low values), and the other containing values for ages 3 through 4 (high values), were created. By comparing the two files, it was determined that this procedure resulted in two completely distinct sets of nutrient values, one low and one high. The high and low nutrient values were then compared to those generated in the processed study data which used actual session dates and birth dates. This comparison confirmed that records in the processed study file for children ages 1 through 2 in fact contained the lower calculated nutrient values and that the records for

children ages 3 through 4 contained the higher values. The shift in calculated nutrient values from lower to higher occurred exactly at age 3.

It was concluded from these tests that the method of data entry and nutrient calculation used by the study was consistent and reliable and generated the values intended by the designers of the Harvard WICENTER program. Had the Harvard FFQ data been entered using solely the WICENTER programs, the resulting calculations would have been both inconsistent and unreliable for the children's records.

Errors Encountered in the Harvard FFQ, Scoring Templates and Instructions

During data collection, several minor graphic errors were encountered in the revised Harvard Spanish FFQ. Page 2 of the scoring template does not align properly with the questionnaire grids and score boxes on the printed instrument. Additionally there are two extraneous score boxes which appear under columns 8 and 9 on page 2 of the printed instrument. Project field staff thought that these errors made the Harvard Spanish instrument more difficult to score and could result in erroneous manual scores.

A discrepancy was also discovered in the Harvard FFQ manual scoring instructions applicable to both the English and Spanish instruments. In some instances, it is possible to have both a positive (+) and a negative (-) result when scoring page 2. Instructions printed on the scoring template do not explain how to score or resolve a pattern of answers when it matches two conflicting levels of the scoring gnd

APPENDIX E-3

DECISION RULES FOR EDITING DIETARY RECALL DATA

In some cases, nutrient estimates from individual 24-hour recalls were improbably high, and appeared to result from erroneous responses. To identify such recalls consistently and systematically, the following decision rules were determined based on examination of actual recall data.

Protein rule: If one recall is more than twice the average of the other two recalls, exclude it. Exception: If two of the three are quite high (e.g., > 100 gm.), don't drop any.

Vitamin C rule: If one recall is more than three times the sum of the other two recalls, exclude it. Or, if one recall is more than 500 mg in that day, exclude it.

Iron rule: If one recall is more than 40 mg and greater than the sum of the other two, exclude it. Or, if one recall is more than 50 mg in that day, exclude it.

Calcium rule: If one recall is more than 2,500 mg in that day <u>and</u> more than the sum of the other two recalls, exclude it. Or, if one recall is more than 1,000 mg in that day <u>and</u> more than three times the sum of the other two recalls, exclude it.

Vitamin A rule: Don't exclude any single recalls on the basis of their difference from the other two recalls. (Upon examination, most high 'outliers' turned out to be carrots or liver, which resulted in legitimate extreme values.)

Energy rule: We did not exclude individual recalls on the basis of energy considerations.

APPENDIX E-4

GUIDELINES FOR FFQ USABILITY ASSESSMENT

The following instructions are excerpted from the guidelines provided to the WIC Agencies in Delaware, North Dakota and Puerto Rico. Each agency submitted a non-quantitative usability assessment of the Harvard and Block FFQs. The results are reported in Section 4.

We are examining the validity of two different types of food frequency questionnaires for use in WIC clinics. Each of these questionnaires has been self-administered by over 700 WIC clients. We would like from you a separate assessment of how usable these questionnaires might be in <u>your</u> context and with <u>your</u> clients.

Enclosed are twelve copies each of eight food frequency questionnaires:

<u>Type A</u>		**<u>Type B</u>**	
AWE	"A", Women's, English	BWE	"B", Women's, English
ACE	"A", Children's, English	BCE	"B", Children's, English
AWS	"A", Women's, Spanish	BWS	"B", Women's, Spanish
ACS	"A", Children's, Spanish	BCS	"B", Children's, Spanish

In order to assess the usability of these questionnaires within your WIC program, it is suggested you use these questionnaires with a small number of clients. For the purposes of the validation study, you can use each type of questionnaire with as many as twelve WIC clients. To gain a good assessment of usability, it is suggested that you substitute your current questionnaire or assessment method with one of the study questionnaires. You may also wish to have members of your staff review the questionnaires and provide an assessment of their usability.

Enclosed are instructions for the administration, scoring and interpretation of each food frequency questionnaire type. Samples of completed questionnaires are also included. The questionnaires are designed to be self-administered, however, it is recommended that you briefly review the basic instructions for completing the questionnaire with each client.

We would ask that you provide us a written assessment of each of the food frequency questionnaires. It would be especially useful if you provide comparisons of type "A" and type "B" In your assessment, please address the following questions for both type "A" and type "B" questionnaires:

continued

- Did you find the questionnaires useful for nutrition education?
- Did you find the manual scoring systems useful for nutrition education?
- Did you find the manual scoring systems helpful in making eligibility decisions?
- What characteristics of the questionnaires make them easy/difficult to use by WIC clients?
- What characteristics of the questionnaires make them easy/difficult to administer by WIC staff?
- What characteristics of the questionnaires make them easy/difficult to score and interpret by WIC staff?
- How suitable are the questionnaires for use with WIC clients in the following ethnic groups: African Americans, Hispanics, Whites? Address those groups who utilize your program.

Please feel free to report any other aspect of the questionnaires which makes them particularly useful or hinder their use. You may want to include suggestions for improving their effectiveness. Your assessment and input are invaluable to the validation study and will be included in the study's final report to USDA later this year.

APPENDIX E-5

SUGGESTED CHANGES TO IMPROVE THE BLOCK FFQ

As noted in Section 4.5, both FFQs consistently overestimated calcium and vitamin A intake. This was true to a greater extent for the Harvard FFQ than the Block FFQ. While the Harvard FFQ permits respondents to indicate frequencies as high as six times per day for all foods, the Block FFQ permits only a maximum of twice a day for solid foods. However, for beverages the Block FFQ did permit respondents to indicate consumption as high as *five to six times per day*. It was hypothesized that this beverage section of the Block FFQ, with its high permissible frequencies, might be the source of some overestimates (see Section 4).

The Block nutrient estimates were recalculated after re-scoring all beverage frequencies higher than three times per day so that a maximum of only three times per day was permitted. Correlations of the resulting nutrient estimates with the diet recall data were then recalculated using Spearman correlations. The results are shown in Table E 5-1 (FFQ-1). For African-American women, the correlations of all nutrients except iron were improved slightly by about 0.02 (for example, the correlation for calcium improved from 0.45 to 0.47). Among White women the improvements were more substantial. The correlation for energy increased from 0.43 to 0.46; for protein from 0.50 to 0.56; and for calcium the correlation increased from 0.55 to 0.61. The result was that among White women four of six nutrient correlations were above 0.50, and two of those were above 0.60.

This change also improved the estimates of group means. For example, among White women the calcium estimate was reduced somewhat (Recall, 1,007 mg; FFQ, 1,180 mg), but remained a significant overestimate. Vitamin A, while still significantly overestimated, was less so (Recall, 940 RE, FFQ, 1,166 RE). A similar pattern of results was seen for the other ethnicities and for FFQ-2 (Table E 5-2).

Table E 5-1

Changes in Correlations as a Result of Re-calculating Frequency Categories for Milk Items with FFQ-1 Data

Spearman correlation coefficients

	Original Calculation	Re-calculation	*difference*
African-American Women			
Energy	0.48	0.50	*0.02*
Protein	0.45	0.47	*0.02*
Vitamin A	0.24	0.26	*0.02*
Vitamin C	0.35	0.36	*0.01*
Iron	0.34	0.34	*0.00*
Calcium	0.45	0.47	*0.02*
Hispanic Women			
Energy	0.11	0.10	*-0.01*
Protein	0.04	0.04	*0.00*
Vitamin A	0.22	0.22	*0.00*
Vitamin C	0.19	0.21	*0.02*
Iron	-0.05	-0.05	*0.00*
Calcium	0.13	0.13	*0.00*
White Women			
Energy	0.43	0.46	*0.03*
Protein	0.50	0.56	*0.06*
Vitamin A	0.60	0.61	*0.01*
Vitamin C	0.19	0.24	*0.05*
Iron	0.50	0.51	*0.01*
Calcium	0.55	0.61	*0.06*
All Women			
Energy	0.36	0.37	*0.01*
Protein	0.33	0.34	*0.01*
Vitamin A	0.33	0.33	*0.00*
Vitamin C	0.30	0.33	*0.03*
Iron	0.23	0.23	*0.00*
Calcium	0.39	0.41	*0.02*

Table E 5-2

Changes in Correlations as a Result of Re-calculating Frequency Categories for Milk Items with FFQ-2 Data

Spearman correlation coefficients.

	Original Calulation	Re-calculation	*difference*
African-American Women			
Energy	0.43	0.44	*0.01*
Protein	0.41	0.42	*0.01*
Vitamin A	0.13	0.14	*0.01*
Vitamin C	0.35	0.36	*0.01*
Iron	0.44	0.45	*0.01*
Calcium	0.40	0.41	*0.01*
Hispanic Women			
Energy	0.08	0.08	*0.00*
Protein	0.11	0.11	*0.00*
Vitamin A	0.06	0.07	*0.01*
Vitamin C	0.28	0.27	*-0.01*
Iron	0.07	0.07	*0.00*
Calcium	0.24	0.23	*-0.01*
White Women			
Energy	0.45	0.48	*0.03*
Protein	0.48	0.51	*0.03*
Vitamin A	0.61	0.60	*-0.01*
Vitamin C	0.34	0.33	*-0.01*
Iron	0.49	0.49	*0.00*
Calcium	0.49	0.55	*0.06*
All Women			
Energy	0.31	0.32	*0.01*
Protein	0.33	0.34	*0.01*
Vitamin A	0.24	0.24	*0.00*
Vitamin C	0.35	0.35	*0.00*
Iron	0.33	0.33	*0.00*
Calcium	0.40	0.41	*0.01*

APPENDIX E-6

NATIONAL ESTIMATES OF NUTRIENT INTAKE FOR WIC WOMEN AND CHILDREN

Although the participant recruitment was not designed to be representative of the nation-wide WIC client population (not a necessary requirement for validation studies), a weighted analysis of the data to approximate nutrient estimates for this population was requested by OMB. Using the recall intake data from this validation study, estimations could be made for the limited population of African-American, Hispanic and White women and children. These data are then weighted to the proportions of these ethnic groups across WIC categories using USDA's *1992 Study of WIC Participant and Program Characteristics.* The formula used for the weighting is:

$$\mathbf{Wgt = (P_{ij}/P_{tot}) * (s_{tot}/s_{ij})}$$

where:

$\mathbf{P}_{ij}$ is the number of WIC participants in a given ethnic group (i) and category (j);.
$\mathbf{P}_{tot}$ is the total number of African-American, Hispanic and White WIC participants;
s_{ij} is the number of study participants in a given ethnic group (i) and category (j);
s_{tot} is the total number of African-American, Hispanic and White study participants.

The proportions used for the WIC participants as of 1992 are as follows:

	Women				Children
	Pregnant	Breastfeeding	Non-Breastfeeding	Total Women	
African-American	0.16	0.02	0.07	0.25	0.30
Hispanic	0.17	0.06	0.05	0.28	0.16
White	0.28	0.08	0.11	0.47	0.54
Total	0.61	0.16	0.23	1.00	1.00

The results of these weighted estimates are shown in Table E 6-1.

Table E 6-1

National Estimates of the Nutrient Intake of WIC Participants based on African-American, Hispanic, and White Diet Recall Data

Weighted to 1992 WIC Participant Data

Nutrient		All Women	Children
		n = 469	*n = 181*
Energy	*median*	**1,927**	**1,350**
(kcal)	*mean*	2,022	1,359
	SD	615	396
Protein	*median*	**78.4**	**50.8**
(gm)	*mean*	80.7	51.1
	SD	27.2	14.4
Vitamin A	*median*	**811**	**549**
(RE)	*mean*	931	616
	SD	516	291
Vitamin C	*median*	**103**	**71**
(mg)	*mean*	120	78
	SD	73	42
Iron	*median*	**14.0**	**10.0**
(mg)	*mean*	14.6	10.6
	SD	5.4	3.6
Calcium	*median*	**887**	**719**
(mg)	*mean*	948	732
	SD	427	768